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NOISE REDUCTIONS ACHIEVED ON A 720-023B AIRCRAFT USING A TWO-SEGMENT APPROACH

By Ray E. Glass

Prepared under Contract No. NAS2-6490 by
HYDROSPACE RESEARCH CORPORATION
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HRC Report No. TR-S-205

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SUMMARY

A flight investigation to determine the operational feasibility of two-segment approaches as a means for reducing airport community noise has been conducted. The effective perceived noise level (EPNL) associated with these approach profiles, using a 720-023B jet aircraft, has been obtained. The tests were designed to determine an operationally optimum approach profile and to quantify the reduction in noise level at predetermined locations on the ground beneath the flight track. This report examines the acoustic aspects of the test program.

The approaches were made using maximum landing weight. The aircraft made instrument landing system (ILS) approaches using two different flap settings. Two-segment approaches were made using 6- and 5-degree upper segment glide slopes with different ILS glide slope intercept altitudes.

The arithmetic average of the noise measurements taken at each of six locations along the ground track were used to compare various test profiles as well as repetitions of both the optimum and reference profiles. The optimum profile was determined to be a two-segment approach utilizing upper segment waypoint coordinates that resulted in a 3000-foot intercept of a 6-degree glide slope to the 400-foot intercept of the Stockton ILS glide slope of 2.5 degrees. The acoustic reference profile was the Stockton ILS approach (2.5-degree glide slope) utilizing 50-degree flaps. The overall noise reduction on the ground track, from 1 to 6 nautical miles, varied between 6.5 and 17.3 EPNdB (effective perceived noise level in decibels).

An analysis of the optimum and reference profiles was made using a group of pilots. Information was also obtained on the types of pilot operational procedures used for the optimum profile.

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INTRODUCTION

The concerned reactions of communities near existing and planned airports has placed added emphasis upon the search for methods to alleviate aircraft noise. One solution to the problem is the use of operational procedures for noise abatement. This report deals with the noise aspect of a program utilizing operational procedures for noise abatement on approach. A number of prior studies, References 1 through 7, have shown that selected approach procedures can result in significant noise reductions.

The purpose of the acoustic portion of the test was to measure, evaluate, and identify the noise levels during various types of aircraft approaches. Six noise measurement sites were positioned on the centerline of the approach ground track. Three of the six microphones were later moved to positions perpendicular to the approach ground track for the last two days of the test. The six noise measurement stations on the approach ground track were positioned between approximately 1 and 6 nautical miles from runway threshold. The 1-nautical mile point was chosen as the beginning of the ground track because it is specified as the approach measurement point in the FAA noise certification requirements. The 6-nautical mile point was chosen for its proximity to the point on the ground beneath the upper segment glide slope transition.

The flight tests were conducted during the months of August and September 1971 at the Stockton Metropolitan Airport with the assistance of NASA - Ames Research Center, American Airlines, Bell Aerospace, Battelle-Columbus Laboratories, and the San Diego noise measurement staff of Hydrospace Research Corporation.

APPARATUS AND METHODS

Aircraft

The aircraft used for the test was a 720-023B jet. Typically, the aircraft flew 12 approaches per day. The first five approaches were practice two-segment approaches where the pilot tried different approach operational techniques. The second group of five approaches were two-segment approaches using the optimum profile determined from operational considerations and predicted noise levels. The remaining two flights were normal ILS approaches using the Stockton 2.5-degree glide slope and 50-degree flaps to establish the baseline noise level.

The aircraft was fueled daily at Moffett Field, California. The aircraft typically weighed 175,000 pounds at the beginning of the sixth approach and 160,000 pounds at the end of the twelfth approach. This results in a 2000-pound weight reduction for each approach.

Navigation and command data were recorded on board the aircraft during all flights.

Acoustic Measurements

Acoustic data were acquired using six battery operated remote-controlled, portable acquisition systems. Figure 1 presents a block diagram of the systems. The typical system utilizes a two-channel analog tape recorder. One channel records acoustic data and the other channel records an IRIG B time signal. The time is broadcast over a radio link at 162.275 mHz (mega Hertz). The time signal is a 1-kHz (kilo Hertz) modulated carrier. The received time signal serves two functions: 1) it provides a common recorded time base for all six systems and 2) the 1-kHz carrier operates a tape motion controller built by Hydrospace Research Corporation.

Field technicians checked system operation and tape supply and administered a single-frequency tone calibration at least once an hour.

Each system was calibrated over a frequency range of 40 to 12,000 Hz using an electrical signal once a week. Figure 2 is a typical total system frequency response. The high frequency pre-emphasis is removed during processing but provides a better signal for analog recording since it compensates for high frequency sound attenuation due to the atmosphere.

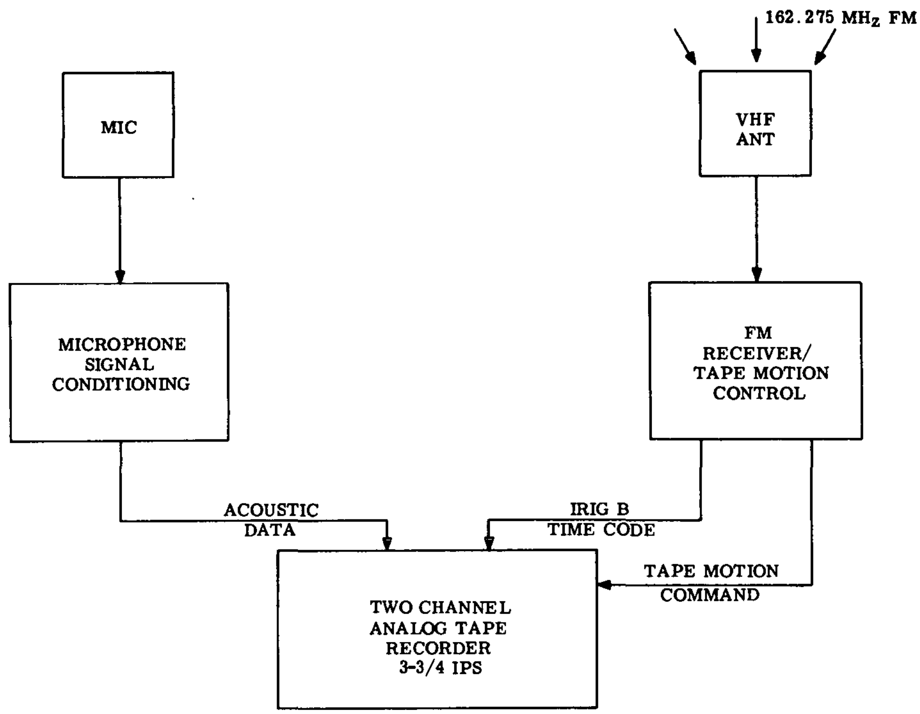

Figure 1. Acoustic Data Acquisition System

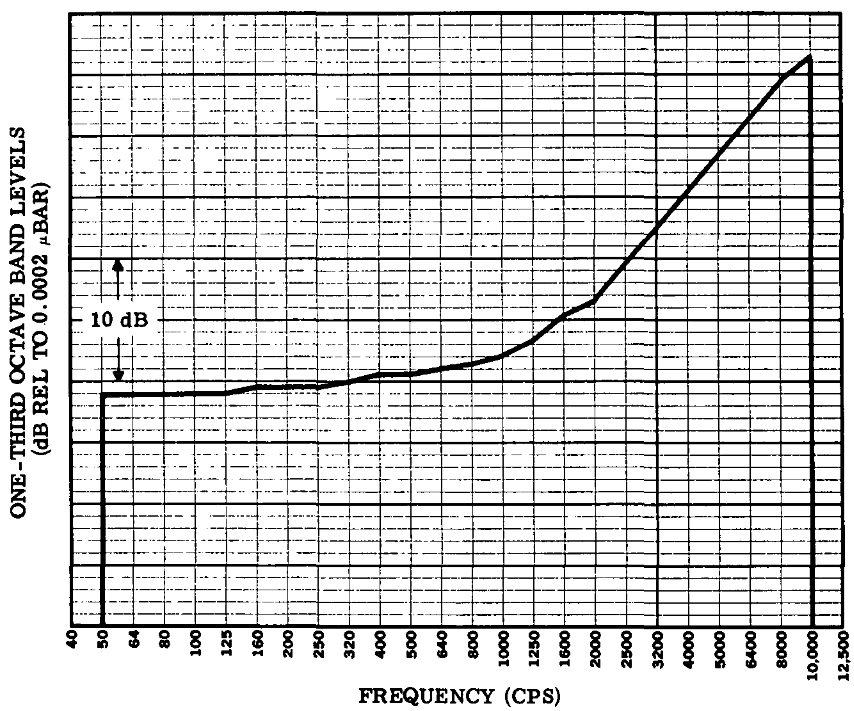

Figure 2. Typical System Response

Acoustic measurement sites 1, 2, 3, 4, 5, and 6 are located under the aircraft approach path. Sites 7, 8, and 9 were sideline measurement locations used only on 2 and 3 September.

Table 1 presents the positioning of the nine sites used during the exercise. All distances along the extended centerline are referenced to the runway threshold. Only six noise measurement sites were operated at any time.

Table 1. Noise Measurement Site Locations

Site	Distance From Runway Threshold (ft)	Distance Perpendicular to Centerline (ft)
1	5,550	0
2	8,300	0
3	13,750	0
4	17,950	0
5	27,150	0
6	36,420	0
7	6,120	1075
8	13,750	1850
9	36,420	3215

All sites were located using a U.S. Geological Survey map. The terrain was flat farmland. Figure 3 shows the noise measurement site locations and major topographical features.

Meteorological Measurements

Weather data were collected at three locations during all acoustic data acquisition. Table 2 contains the meteorological data recorded at a central station (HRC noise van) adjacent to site 3. These data are used to correct raw EPNL to a standard acoustic day using data from Reference 8. Temperature was recorded at 33 feet above the ground using an aspirated wind vane. A Cambridge System hygrometer unit was used to obtain dewpoint temperature. This was located at 20 feet above the ground. Wind speed and direction were recorded at 33 feet above the ground.

Table 3 contains tabulations of meteorological data recorded at the two secondary stations. These stations were at acoustic measurements sites 1 and 5. These stations measured temperature and wind speed 5 feet above the

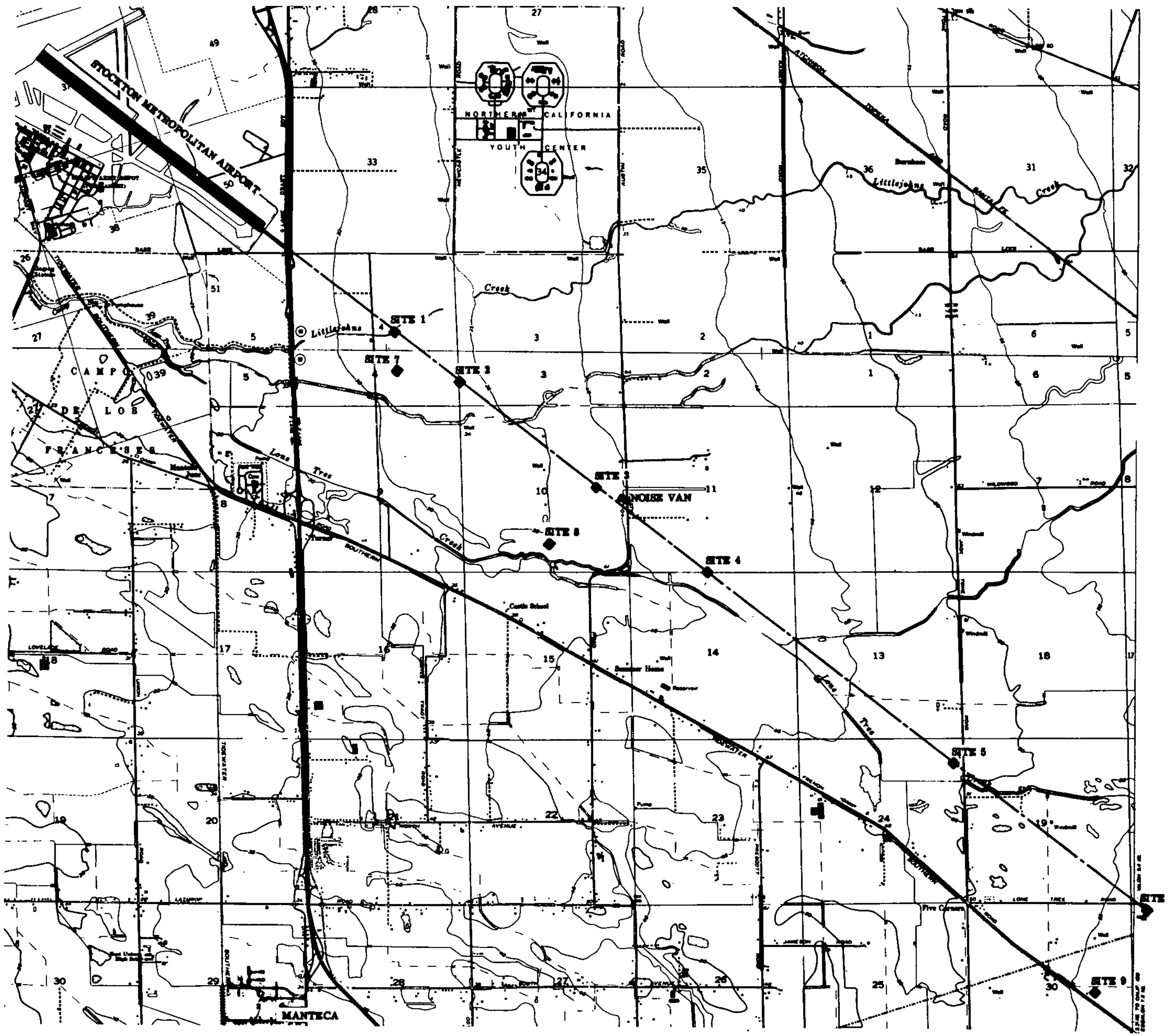

Figure 3. Measurement Site Locations

Table 2. Central Weather Station - Weather Summary, Stockton

Time	Temp (^{o}F)	Humidity (%)	Wind Speed (mph)	Wind Direction (True North)
17 August				
0800	62	62	8	280
0900	67	50	9	310
1000	68	45	5	260
1100	74	40	6	90
19 August				
0700	53	--	0	320
0800	57	89	5	320
0900	60	83	5	330
1000	64	70	5	360
1100	68	57	5	340
23 August				
1300	76	54	11	270
1400	79	47	5	280
24 August				
1300	74	50	5	290
1100	76	54	8	280
1200	80	39	7	320
25 August				
0900	70	60	0	040
1000	72	49	5	330
1100	75	47	5	310
26 August				
0900	64	78	7	320
1000	66	73	10	360
27 August				
0800	56	94	5	340
0900	64	68	5	360
31 August				
1000	63	59	12	300
1100	65	56	15	300

Table 2. Central Weather Station - Weather Summary, Stockton (Contd)

Time	Temp (^oF)	Humidity (%)	Wind Speed (mph)	Wind Direction (True North)
1 September				
0800	59	82	0	270
0900	61	72	5	290
1000	63	72	12	280
2 September				
0800	58	88	5	260
0900	64	68	8	290
1000	65	68	10	300
3 September				
0800	57	63	7	320
0900	62	48	9	320
1000	65	49	15	320

Table 3. Secondary Weather Stations - Weather Summary, Stockton

SITE 1			SITE 5		
Time	Temp (^oF)	Wind Speed (mph)	Time	Temp (^oF)	Wind Speed (mph)
17 August					
0800	--	--	0800	70	7
0900	70	6	0900	72	6
1000	73	4	1000	76	6
1100	79	8	1100	79	8
19 August					
0700	60	3	0700	56	0
0800	61	4	0800	60	5
0900	66	4	0900	69	5
1000	76	4	1000	72	5
1100	--	--	1100	78	6

Table 3. Secondary Weather Stations - Weather Summary, Stockton (Contd)

SITE 1			SITE 5		
Time	Temp (^{o}F)	Wind Speed (mph)	Time	Temp (^{o}F)	Wind Speed (mph)
23 August					
1300	--	--	1300	87	8
1400	--	--	1400	91	7
24 August					
1000	--	--	1000	83	4
1100	--	--	1100	86	5
1200	--	--	1200	91	7
25 August					
0900	--	--	0900	73	2
1000	--	--	1000	81	2
1100	--	--	1100	--	--
26 August					
0900	--	--	0900	69	10
1000	--	--	1000	73	10
27 August					
0800	--	--	0800	62	8
0900	--	--	0900	66	5
31 August					
1000	67	13	1000	70	13
1100	69	12	1100	72	13
1 September					
0800	66	--	0800	62	5
0900	68	7	0900	66	7
1000	73	6	1000	71	14
2 September					
0800	--	--	0800	62	6
0900	64	4	0900	65	9
1000	68	4	1000	71	10
3 September					
0800	63	5	0800	59	5
0900	64	5	0900	66	7
1000	67	7	1000	70	5

ground. These meteorological measurements were used to evaluate the weather trends over the test range.

The central station temperature is usually lower than that temperature measured at the secondary stations. The central station temperature is a very close approximation to the temperature along the acoustic path. The secondary station temperature is affected by ground heating.

Although the wind speed exceeded the 10-knot (11.5-mph) criteria in Reference 9 during some periods of the test, the microphone windscreens reduced the effects of wind noise well below the 10-dB down points of the measured aircraft noise. The other factors of importance due to wind are its effects on the flight profile and effects of wind gradients on sound propagation. The aircraft flew consistent profiles even when the wind exceeded 10 knots. Since no upper wind data were acquired, the effect of wind gradients cannot be ascertained; however, based on visual weather observations during the test period, the wind gradients were insignificant.

Aircraft Tracking

Radar tracking was provided by a Bell Aerospace radar unit. The radar provided both an on-line two-dimensional plot and analog three-dimensional data. Acoustic data processing was performed using the on-line two-dimensional radar plot. The two dimensions were slant range to touchdown and altitude. The radar operator gave a 'mark' at the first time pulse on the analog two-dimensional plot. (This mark was noted by the HRC noise van operator.) Although the radar plot did not contain IRIG B time code directly, a timing pulse was generated every 15 seconds during the approach. The mark and subsequent pulses allowed HRC personnel to correlate the aircraft track to a common time base. Figure 4 is a typical radar plot.

Although three-dimensional digital tracking data is more accurate, the available two-dimensional track will introduce a maximum error in the acoustic results of less than ±0.25 EPNdB for this test. This figure is based on atmospheric absorption differences between the true slant range at the time of maximum tone-corrected perceived noise level ($PNLT_{max}$) and vertical distance at the time of $PNLT_{max}$. For this reason, one may also plot EPNL as a function of slant range from the two-dimensional track with a minimum of error.

Timing Synchronization

The time code generator, located in the Hydrospace Research Corporation noise van, was synchronized daily to the National Bureau of Standard's broadcast time. The time code generator would output an IRIG B time signal

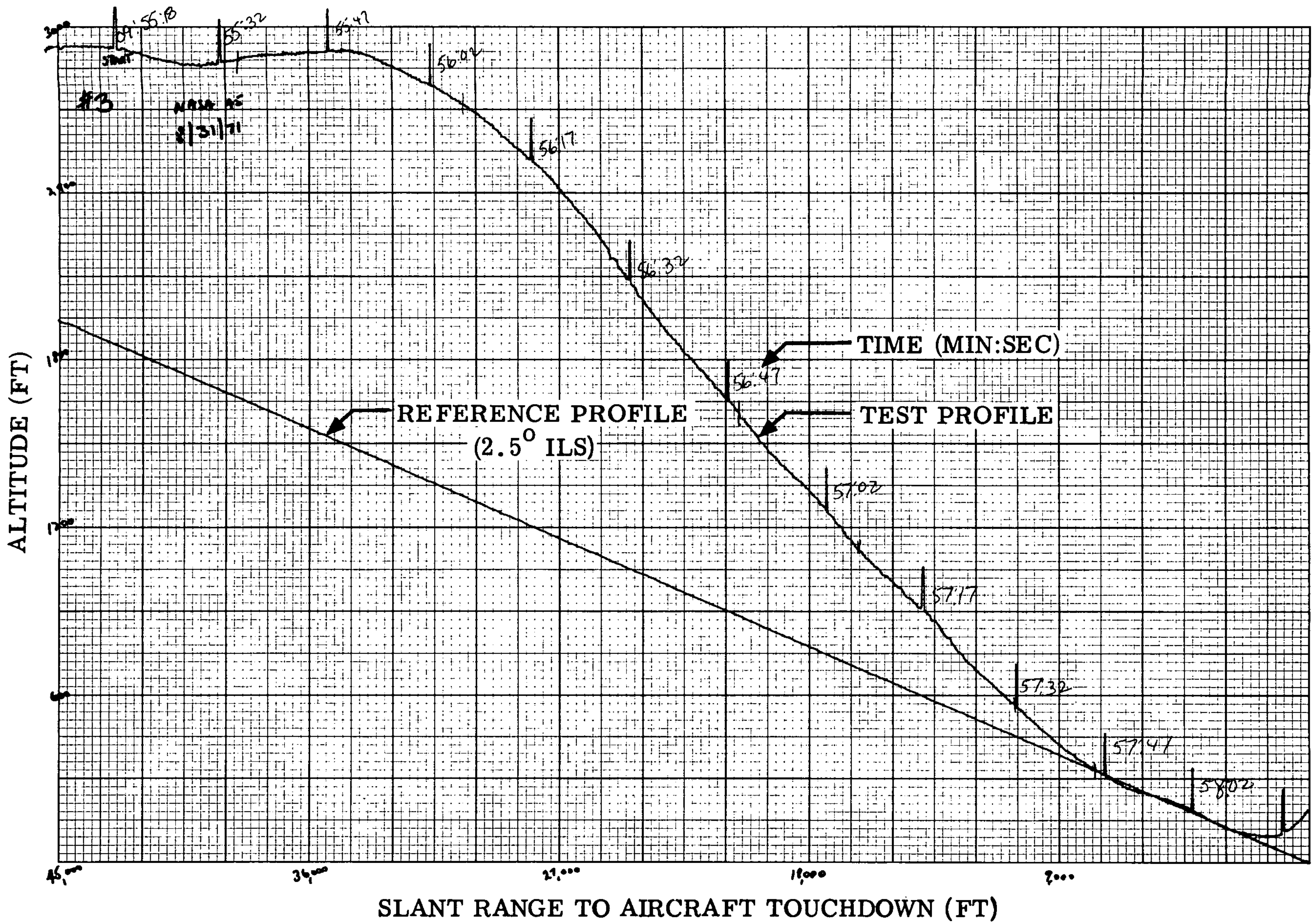

Figure 4. On-Line Radar Plot

which was transmitted over an FM radio link to the aircraft, radar, and all six acoustic data acquisition field systems. The time signal contained hour, minute, and second information with resolution of 1 msec (millisecond). This time code provided a common time base for all data recording.

The timing signal inadvertently transmitted for the last three runs on 19 August and for all runs (5-9) on 23 August was NASA 36 Code instead of IRIG B. Although both codes are modulated 1-kHz carriers, there is a difference in the number of bits.

Communication

Communication between HRC personnel was over a citizen band radio link. The HRC noise van monitored either the NASA test frequency (123.3 mHz) or the Stockton tower (120.3 mHz). Communication with the radar was implemented using a citizen band radio link. The FM timing link was also used by HRC to talk to the radar and the aircraft when the need arose. Figure 5 depicts the communication network.

Acoustic Data Processing

The acoustic data were processed at HRC's San Diego Operations. The processing equipment and the computer program used conform to the requirements of FAR Part 36, Reference 9. The acoustic data were adjusted for system frequency response, effect of windscreen, grazing incidence, effects of temperature and humidity, and effects of background.

Figure 6 is a diagram of the Hydrospace Research Corporation EPNL processing technique. Analog tapes are processed using one-third octave filters to produce a digital tape of the raw one-third octave data every 0.5 seconds along with run number and calibration information. This provides the necessary memory for long duration flyovers and stores the flyover in convenient form for future work with the data. Next, the raw spectra are immediately read back into the computer and converted to true sound pressure levels utilizing the calibration information. This is then converted to raw EPNL. After entry of aircraft range, the computer reads the appropriate atmospheric corrections from digital magnetic tape and calculates corrected EPNL. This EPNL is corrected to a standard day and includes corrections for background, windscreen, grazing incidence, and gain setting. The EPNL and other support data are output to a third digital tape as an even further condensed form of the original analog tape. In addition, EPNL and support data are output to a hard copy. The above sequence is performed for every flight at each site. Additional outputs are presented on a visual display for purposes of quality control. If there are any problems, the run can be reprocessed immediately.

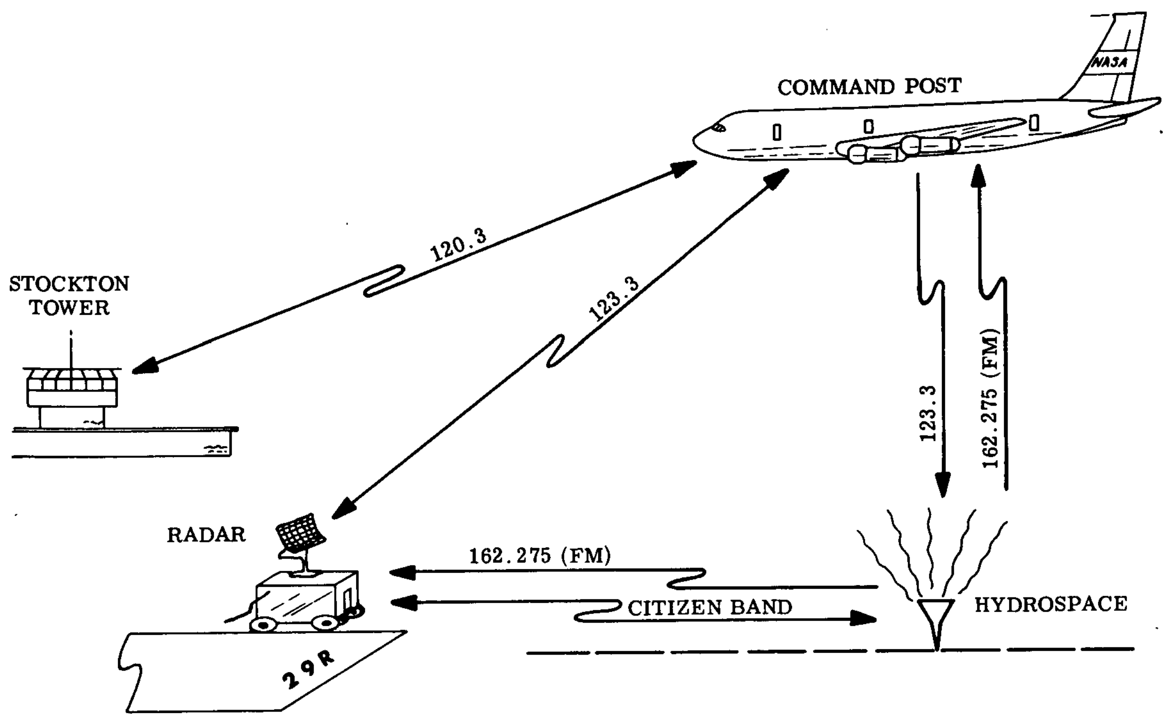

Figure 5. Communications and Command Network, Stockton Airport

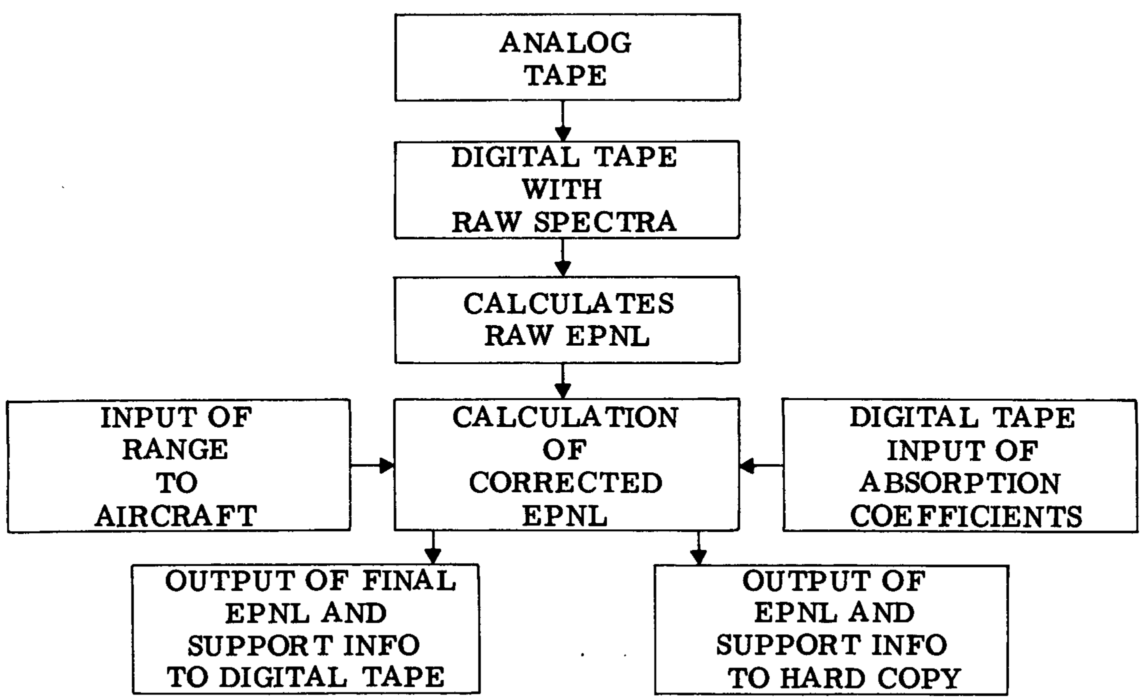

Figure 6. Processing Block Diagram

RESULTS AND DISCUSSION

Daily Results

Acoustic measurements were made on eleven days during a period of three weeks. The results, along with tracking ranges at the closest point of approach (CPA) to each noise measurement site, are contained week by week in Appendixes A, B, and C.

Appendix A contains the results of data obtained on 17 and 19 August. The results of 19 August provide an acoustic baseline. Baseline information was used to determine that effective perceived noise level (EPNL) corrections were not needed for the remaining two weeks' flights due to the decrease in aircraft weight during each day's test. These flights were flown by the project test pilots.

Appendix B contains the results of data obtained on 23 through 27 August. This additional data on the optimum two-segment approach and the normal ILS approach was from flights performed by a number of guest pilots. The plots contain average data. No data acquired during the guest pilot practice runs have been included on the plots.

Appendix C contains the results of data obtained from 31 August through 3 September. Results on 31 August and 1 September are additional data on guest pilot flights of the optimum two-segment approach and the normal ILS approach. The two-segment approaches flown on 2 and 3 September were slightly different from the optimum two-segment approaches previously flown. This difference was due to a change in upper segment waypoint coordinates. Also, three sideline measurements were taken; thus, only three centerline measurement sites were used.

With the exception of data for 17 August, all data in the first three appendixes consist of two tables and three graphs. The first table (see Table A-1 for example) is a log of EPNL at each noise measurement site as a function of approach number. The companion table (Table A-2) is a log of aircraft altitude at CPA for each site as a function of flight number. The first graph (see Figure A-1 for example) depicts the average profiles for both the reference approach (normal ILS with 50-degree flaps) and the optimum two-segment approach. The second graph (Figure A-2) depicts the EPNL as a function of distance along the extended runway centerline. The plotted points show average levels and range of variance at the noise measurement sites. A smooth curve is drawn as an approximation to the levels along the noise ground track. The last graph (Figure A-5) displays EPNL as a function of slant range. This graph explains part of the reduction in noise level due to the two-segment approach. If the only contribution of the two-segment approach was an increase in distance above the ground, then the EPNL versus slant range curve for both approaches would be the same. However, there is typically a 5-EPNdB reduction in EPNL versus slant range for the optimum two-segment approach compared to the normal ILS approach. See Figure A-5 in Appendix A. This points out that factors such as aircraft power also contribute to the total noise reduction.

The daily acoustic and tracking results are included in Appendixes A, B, and C to provide an insight to overall results of the test.

Final Test Results

Figure 7 illustrates a typical range of noise reduction which may be achieved on a given day when various approaches are made. Figure 7 is the noise level for the flights of 17 August. The quietest approach is a two-segment approach with a 3000-foot intercept of a 6-degree glide slope and an intercept of a 2.5-degree glide slope at a nominal 400-foot altitude. The approach profiles are given in Figure 8. The two-segment profile discussed above is identified as the optimum approach because it achieves the maximum noise reduction on the ground, as illustrated in Figure 9.

For analysis purposes, the data from the eleven test days is best broken into three groups. These three groups are as follows:

(1) Group I is the normal Stockton ILS approach using a 2.5-degree glide slope and 50-degree flaps.

(2) Group II is a two-segment approach with 3000-foot altitude intercept of the 6-degree glide slope and a nominal 400-foot altitude intercept of the 2.5-degree glide slope.

(3) Group III are practice approaches using four approach procedures: autopilot, manual visual flight rules (VFR), manual hooded, and intentional excursions from upper segment glide slope.

Table 4 contains the pertinent results of the test. The extremely high confidence values verify that the average levels measured at each noise measurement site are within ±1.5 EPNdB of the true average value.

Figure 9 is an estimate of the maximum noise reduction along the ground track based on six measurement sites. The symbols represent the average noise level at the site. The data scatter is also depicted. The increased levels at sites 3 and 4 during normal Stockton ILS approaches are due to power increases above these sites. The variation of EPNL at sites 5 and 6 for the

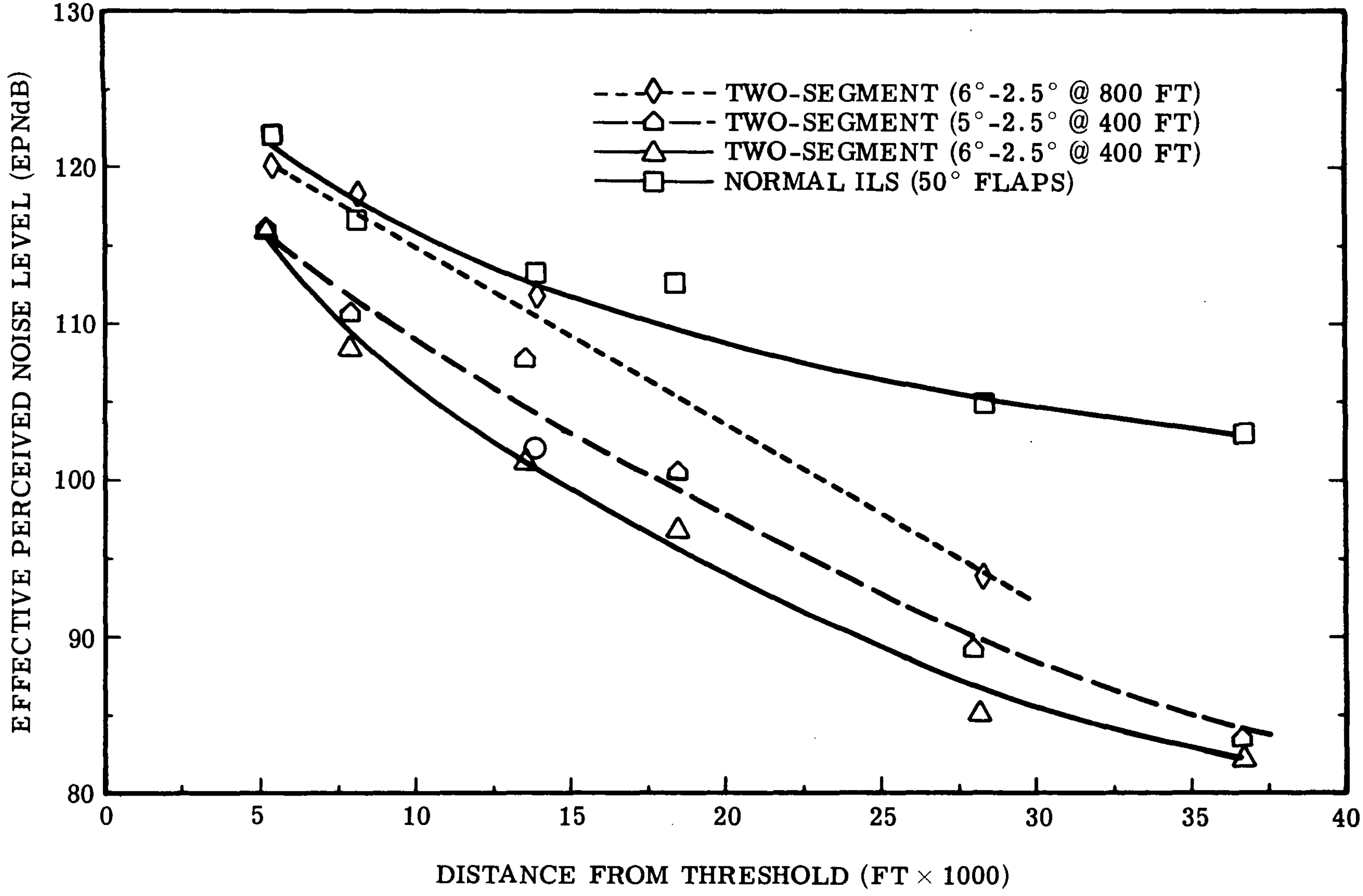

Figure 7. Summary of EPNL Versus Distance From Threshold for Preliminary Flights, 17 August

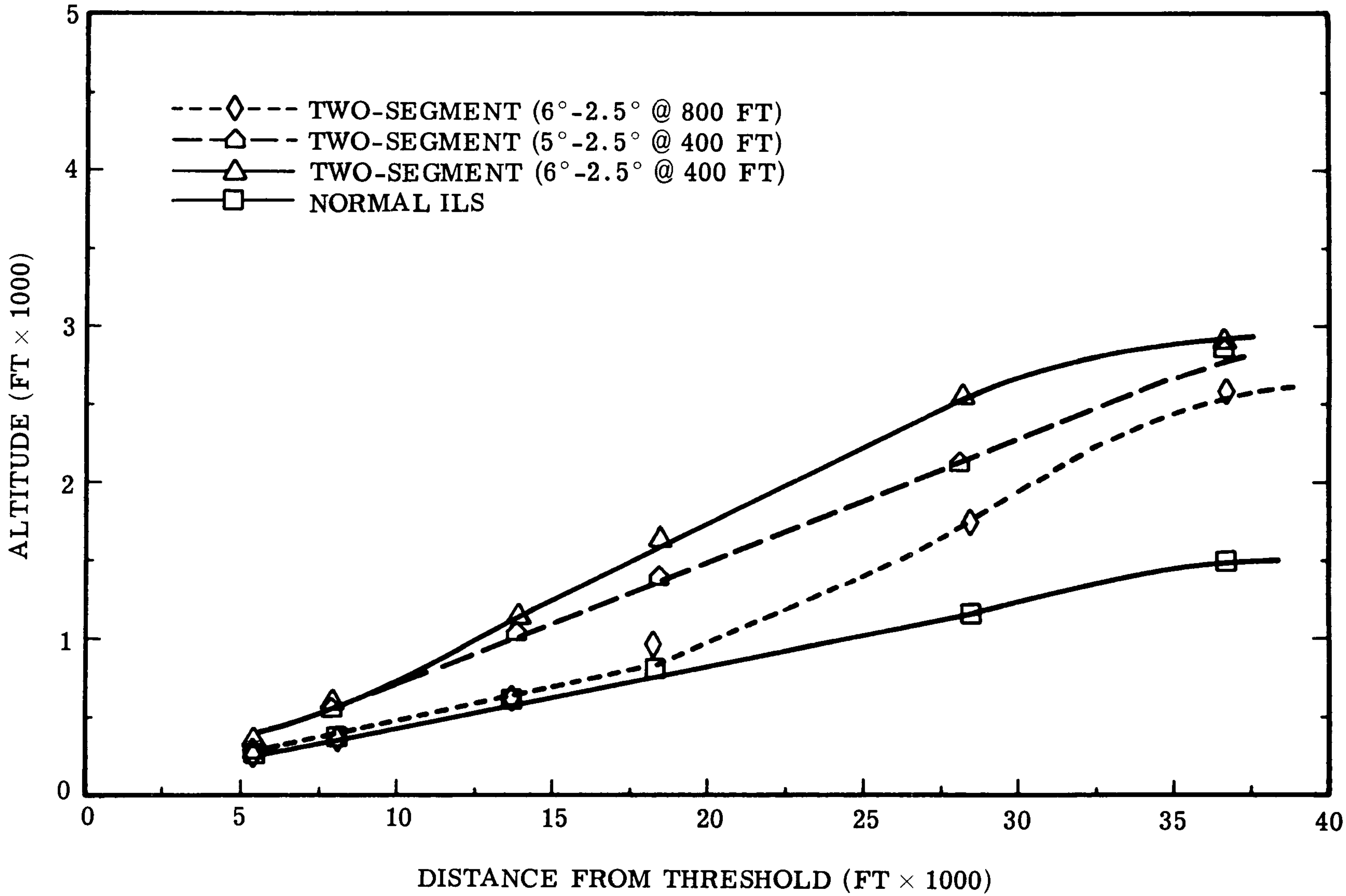

Figure 8. Summary of Approach Profiles for Preliminary Flights, 17 August

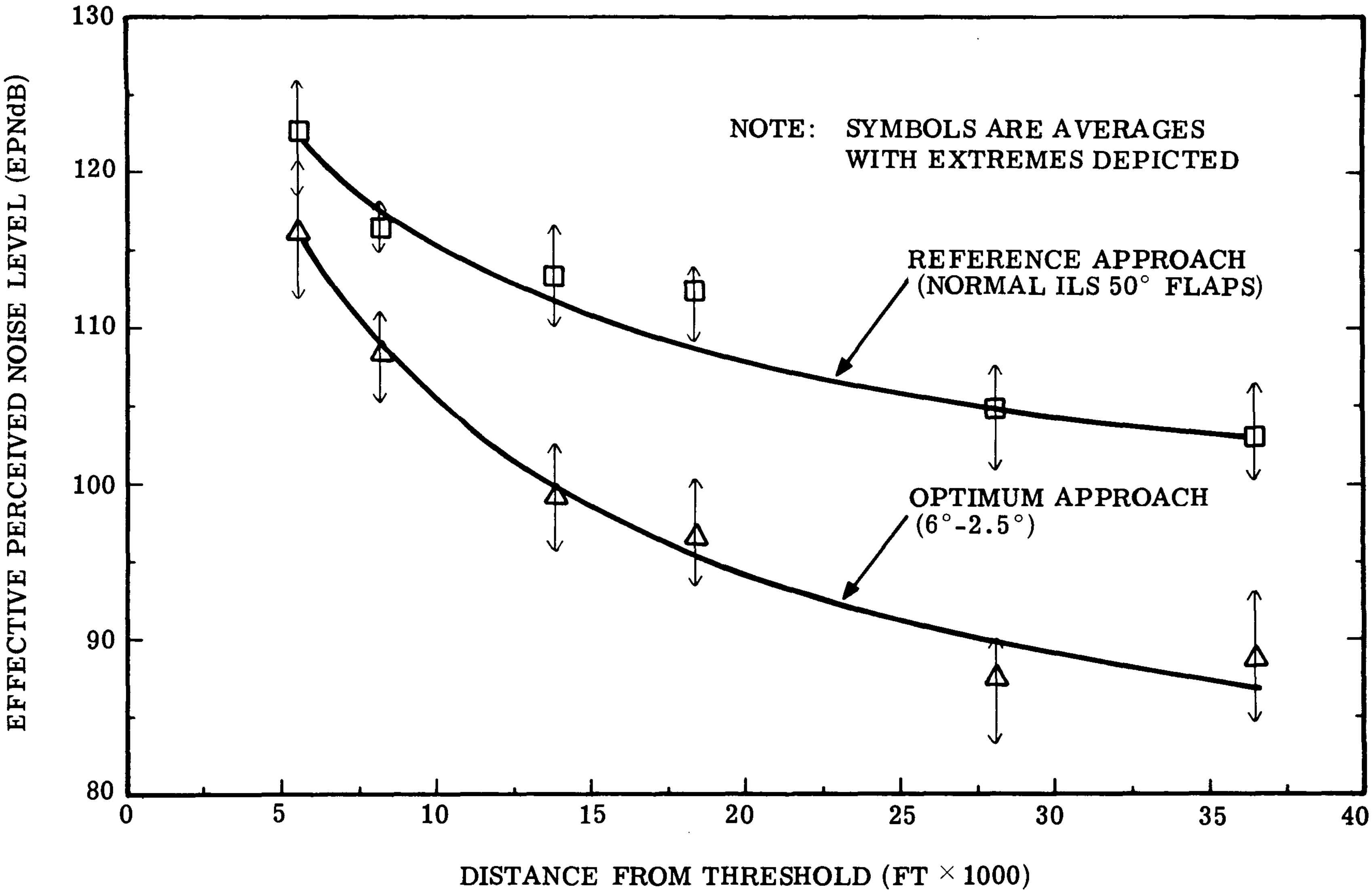

Figure 9. Maximum Reduction in EPNdB Along the Noise Ground Track

Table 4. Log of Final Results

Group	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
I (Normal ILS 50° Flaps) ±1.5 EPNdB Confidence	122.7 98.4%	116.6 99.99%	113.3 99.4%	112.8 99.8%	105.0 96.0%	103.1 98.0%
II (Two Segment) ±1.5 EPNdB Confidence	117.0 99.6%	108.3 99.9%	99.6 99.8%	96.8 99.8%	87.7 99.7%	89.1 99.6%

two-segment optimum approach is attributed to engine power changes, based on an examination of cockpit instrument panel data.

Table 5 identifies the actual noise reduction at points along the ground track where measurement sites were located. These reductions were calculated from approach data obtained using a number of different pilots.

Table 5. Reduction in Noise Due to Optimum Two-Segment Approach (EPNdB)

Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
6.5	8.3	14.0	16.0	17.3	14.1

Appendix D contains histograms of the three basic data groupings. Typically, the practice approaches using the three approach procedures have standard deviations similar to the repetitive data of groups I and II. The data are fairly normally distributed and the standard deviation is small considering the numerous variable parameters inherent in any aircraft tests, especially power changes.

Appendix E contains results of the practice two-segment approaches.

Appendix F presents the average noise levels at the sideline noise measurement sites. Sideline data were taken on 2 and 3 September. Since little sideline data exist for group II approaches (optimum approach), no definite conclusions concerning sideline noise reduction for the optimum approach can be made. However, the limited sideline data indicate that an average 6-EPNdB sideline noise reduction can be expected using this approach.

Appendix G presents contours of EPNL for the standard ILS and the optimum two-segment approach.

Figure C-12 illustrates the problem in calculating noise contours when two-segment approaches are involved. The top cluster of triangles at 1100-foot slant range represent sideline data taken at site 7, which is perpendicular to site 1. At this location, site 7 measures noise from the two-segment approach after the normal ILS glide slope has been acquired. Therefore, the noise levels agree with those measured from the normal ILS approach. Based on these data, it is apparent that care must be exercised in interpretation of EPNL versus slant range data when used in contour computations.

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CONCLUSIONS

The optimum approach profile for this test was a 6-degree glide slope with upper intercept at 3000 feet and a 400-foot intercept of the Stockton glide slope of 2.5 degrees. The Stockton ILS glide slope (2.5°) was chosen as the noise measurement reference profile. The maximum noise reductions achieved in this test program were from 6.5 to 17.3 EPNdB at points from 1 to 6 nautical miles from runway threshold along the approach ground track. The average measured noise levels at each noise measurement site under the approach path are statistically within ±1.5 EPNdB of the true acoustic level at the site for both the reference and optimum profile data. The optimum two-segment approach typically had a standard deviation of approximately 2.5 EPNdB. This is a measure of the actual data scatter.

Two-segment approaches achieve noise reduction from two sources: 1) an increased distance above the ground and 2) a reduction in noise level as a function of slant range due to reduced power settings. Power changes are especially evident at the lower transition where the two-segment has a lower noise level at the same altitude as the ILS approach.

Inclusion of two-segment approaches into present noise exposure forecast (NEF) computations yield answers that are not consistent with actual measurements. Care must be taken in the use of present NEF computation to provide for the power change at the lower transition and for sideline corrections. The upper transition affects the existing NEF prediction techniques less drastically.

Incremental noise levels along the approach ground track are significantly affected by pilot-operating technique, especially power changes. Further reductions of 1 to 2 EPNdB may be achieved at critical points on the approach ground track by control of aircraft attitude, speed, and power changes.

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Appendix A

DAILY ACOUSTIC RESULTS
17 - 19 AUGUST 1971

Table A-1. Project Pilot Noise Levels - 17 August 1971

NORMAL ILS (EPNdB)

Run No.	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
1704	122.22	115.37	115.77	115.11	102.55	100.08
1705	122.50	116.47	115.24	114.88	106.58	103.47
AVG	122.36	115.92	115.50	114.99	104.56	101.77

TWO SEGMENT (6^{o} - 2.5^{o} @ 400) (EPNdB)

Run No.	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
1701	112.78	106.37	100.09	94.58	---	---
1702	117.99	107.98	99.69	95.40	83.57	84.48
1703	114.73	106.87	100.34	96.29	83.74	81.94
1706	120.15	113.08	103.03	100.73	88.27	---
1707	112.52	106.56	101.32	97.37	85.54	---
1708	118.21	109.03	102.60	96.71	85.75	82.45
1709	114.74	108.98	99.68	97.67	85.98	82.82
AVG	115.90	108.40	101.10	96.80	85.50	82.80

TWO SEGMENT (6^{o} - 2.5^{o} @ 800) (EPNdB)

Run No.	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
1710	120.09	118.42	112.20	---	94.59	---

TWO SEGMENT (5^{o} - 2.5^{o} @ 400) (EPNdB)

Run No.	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
1711	117.92	111.26	106.92	---	90.93	83.85
1712	114.06	110.01	108.72	100.54	87.66	82.60
AVG	115.99	110.63	107.82	100.54	89.29	83.22

Table A-2. Project Pilot CPA Distance - 17 August 1971

NORMAL ILS (FT)

Run No.	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
1704	315	395	705	810	1200	1380
1705	295	400	620	810	1190	1400
AVG	305	398	663	810	1195	1390

TWO-SEGMENT (6^{o} - 2.5^{o} @ 400) (FT)

Run No.	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
1701	420	725	880	1695	2655	2955
1702	335	680	1300	1695	2620	2870
1703	380	645	1245	1665	2625	2895
1706	340	445	1060	1445	2370	2875
1707	435	680	1310	1680	2600	2840
1708	375	565	1190	1575	2475	2880
1709	330	550	1130	1545	2480	2850
AVG	373	613	1160	1612	2546	2862

TWO SEGMENT (6^{o} - 2.5^{o} @ 800) (FT)

Run No.	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
1710	315	430	620	900	1785	2625

TWO SEGMENT (5^{o} - 2.5^{o} @ 400) (FT)

Run No.	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
1711	370	535	1005	---	2045	2740
1712	405	620	1015	1370	2155	2865
AVG	388	578	1010	1370	2100	2812

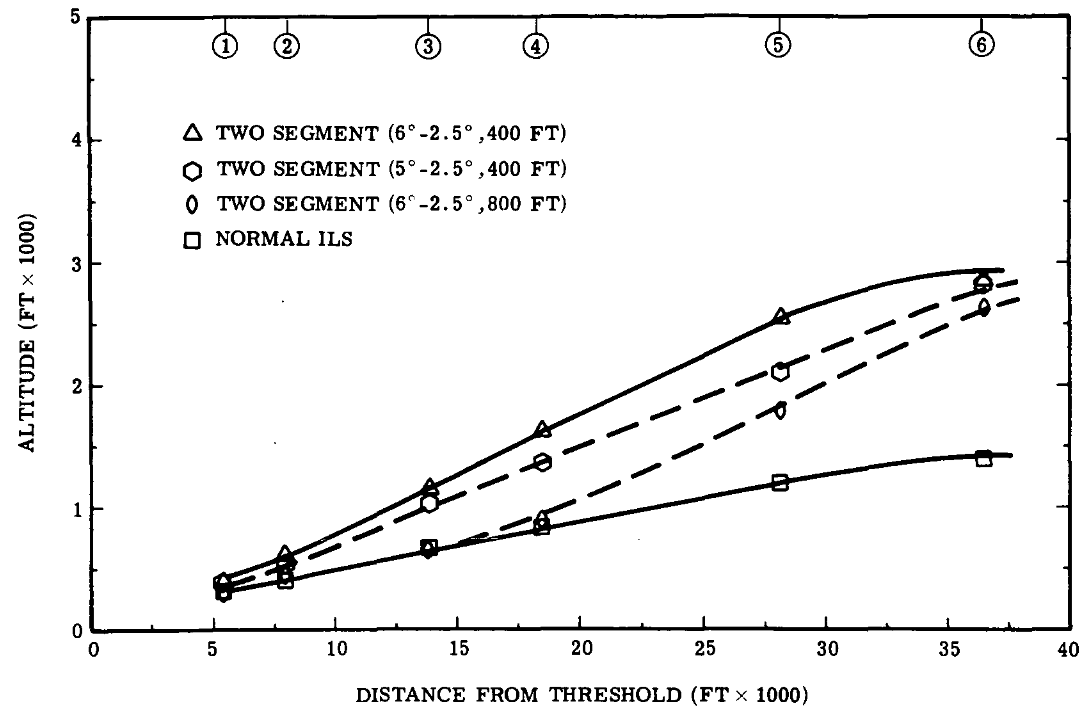


Figure A-1. Average Flight Profiles on 17 August

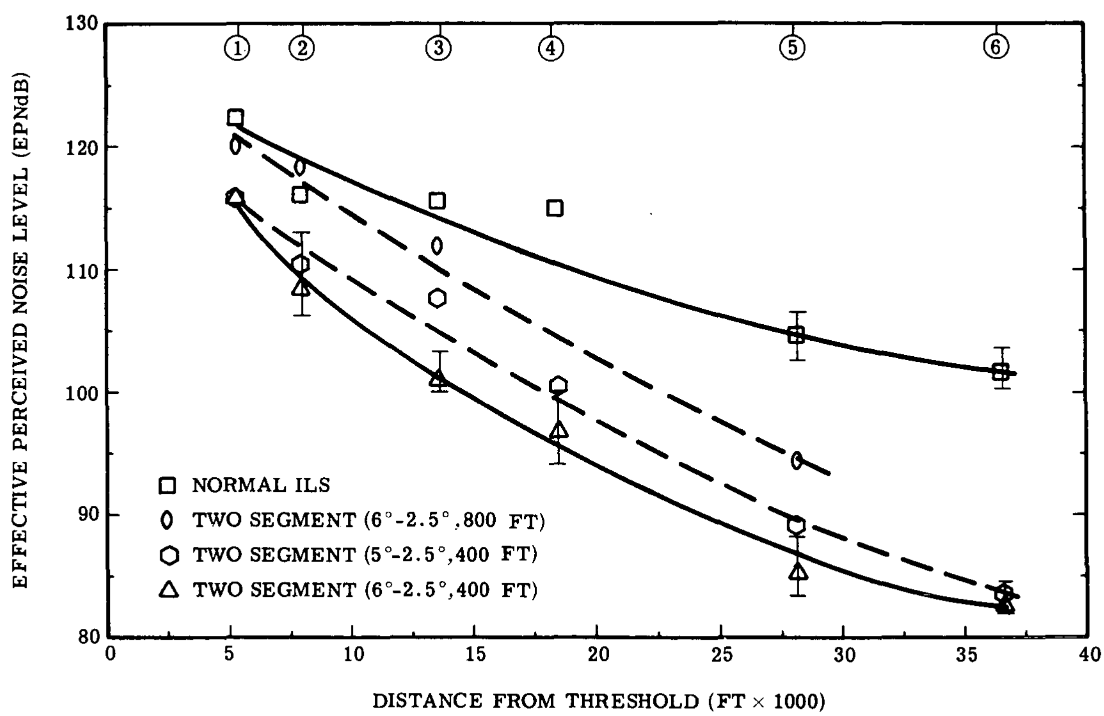


Figure A-2. EPNL Versus Distance Along Centerline on 17 August

Table A-3. Acoustic Baseline Data - 19 August 1971

NORMAL ILS (BASELINE) (EPNdB)

Run No.	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
1901	126.06	117.55	112.48	112.37	101.98	---
1902	126.34	112.12	112.91	113.96	103.20	---
1903	126.98	116.07	112.36	112.98	102.44	101.14
1904	127.21	116.45	111.65	114.16	105.11	100.17
1905	125.88	116.42	113.31	112.87	104.12	102.21
1906	124.53	114.79	109.72	113.27	105.41	102.06
AVG	126.16	115.57	112.07	113.27	103.71	101.39

TWO SEGMENT FOR NOISE MEASUREMENT (EPNdB)

Run No.	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
1907	117.33	---	---	96.52	86.33	84.47
1908	117.64	---	---	95.36	85.04	81.48
1909	117.15	---	---	95.49	86.54	84.90
1910	119.20	108.39	99.25	94.29	85.08	85.59
1911	116.86	105.22	98.80	94.44	84.13	85.25
1912	117.22	107.01	99.41	94.60	84.49	85.41
AVG	117.57	106.87	99.15	95.11	85.27	84.51

Table A-4. Baseline CPA Distance - 19 August 1971

NORMAL ILS (BASELINE) (FT)

Run No.	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
1901	310	405	640	830	1200	1570
1902	300	400	620	820	1215	1455
1903	300	400	640	840	1210	1490
1904	300	405	645	830	1240	1410
1905	300	410	645	830	1215	1460
1906	305	410	630	830	1220	1470
AVG	303	405	637	830	1217	1476

TWO SEGMENT FOR NOISE MEASUREMENT (FT)

Run No.	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
1907	330	550	1150	1700	2750	3020
1908	330	570	1170	1730	2740	3000
1909	300	550	1170	1650	2820	3000
1910	310	525	1170	1670	2800	2955
1911	335	580	1180	1695	2840	2940
1912	380	605	1190	1700	2790	2990
AVG	331	563	1171	1691	2790	2984

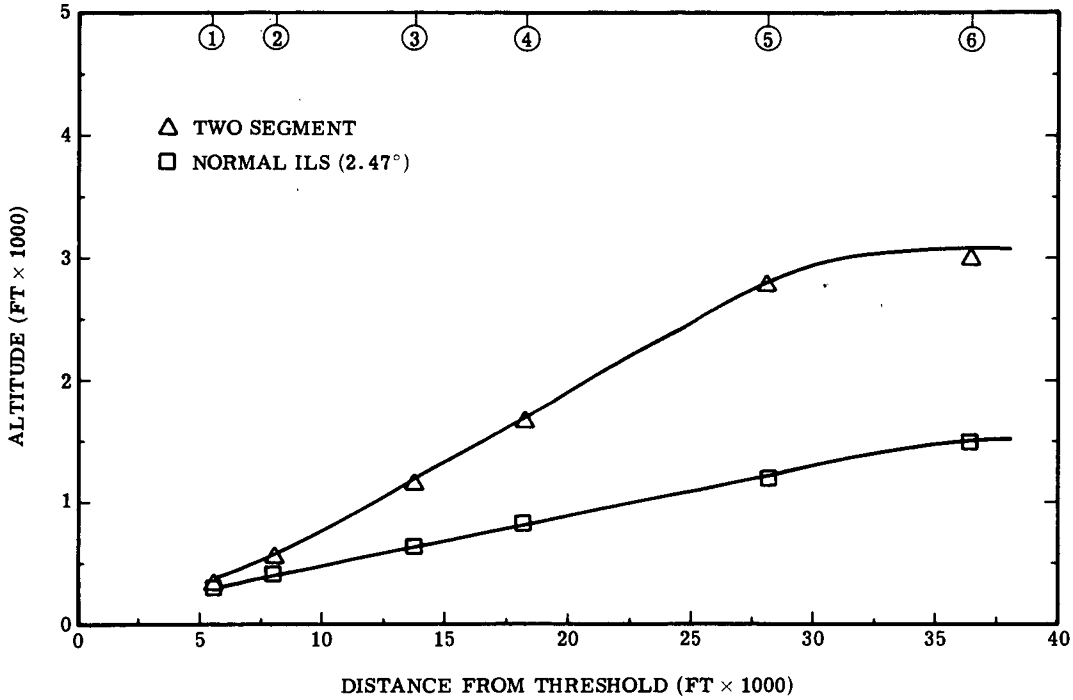


Figure A-3. Baseline Flight Profiles on 19 August

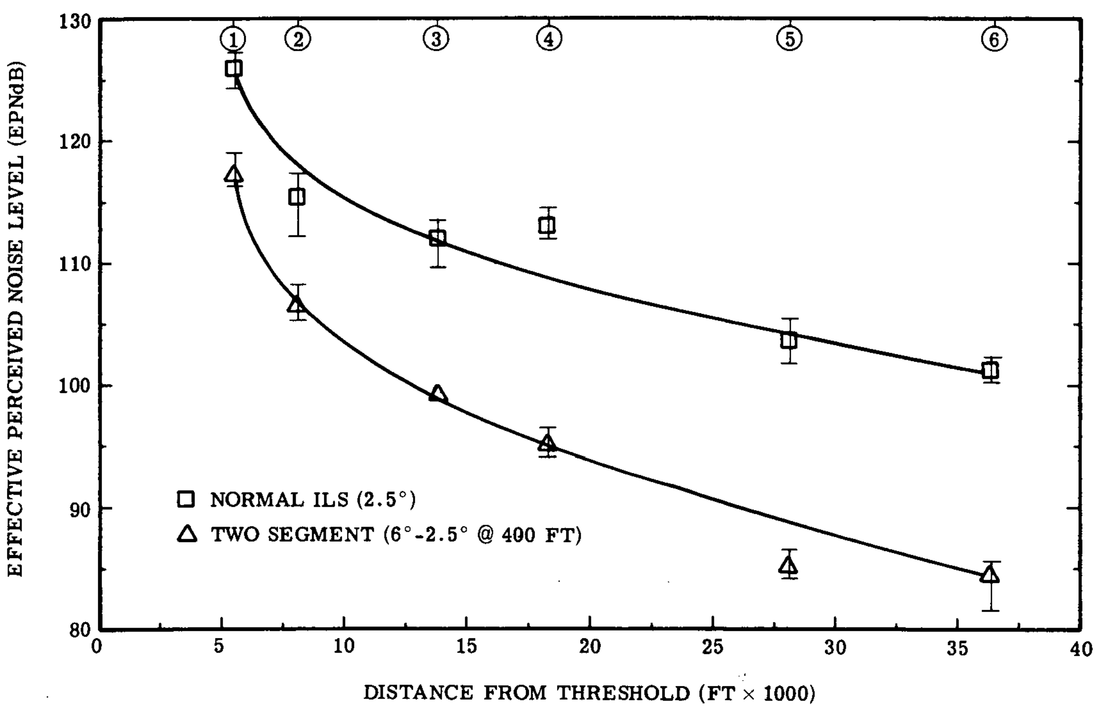


Figure A-4. Baseline EPNL Versus Distance on 19 August

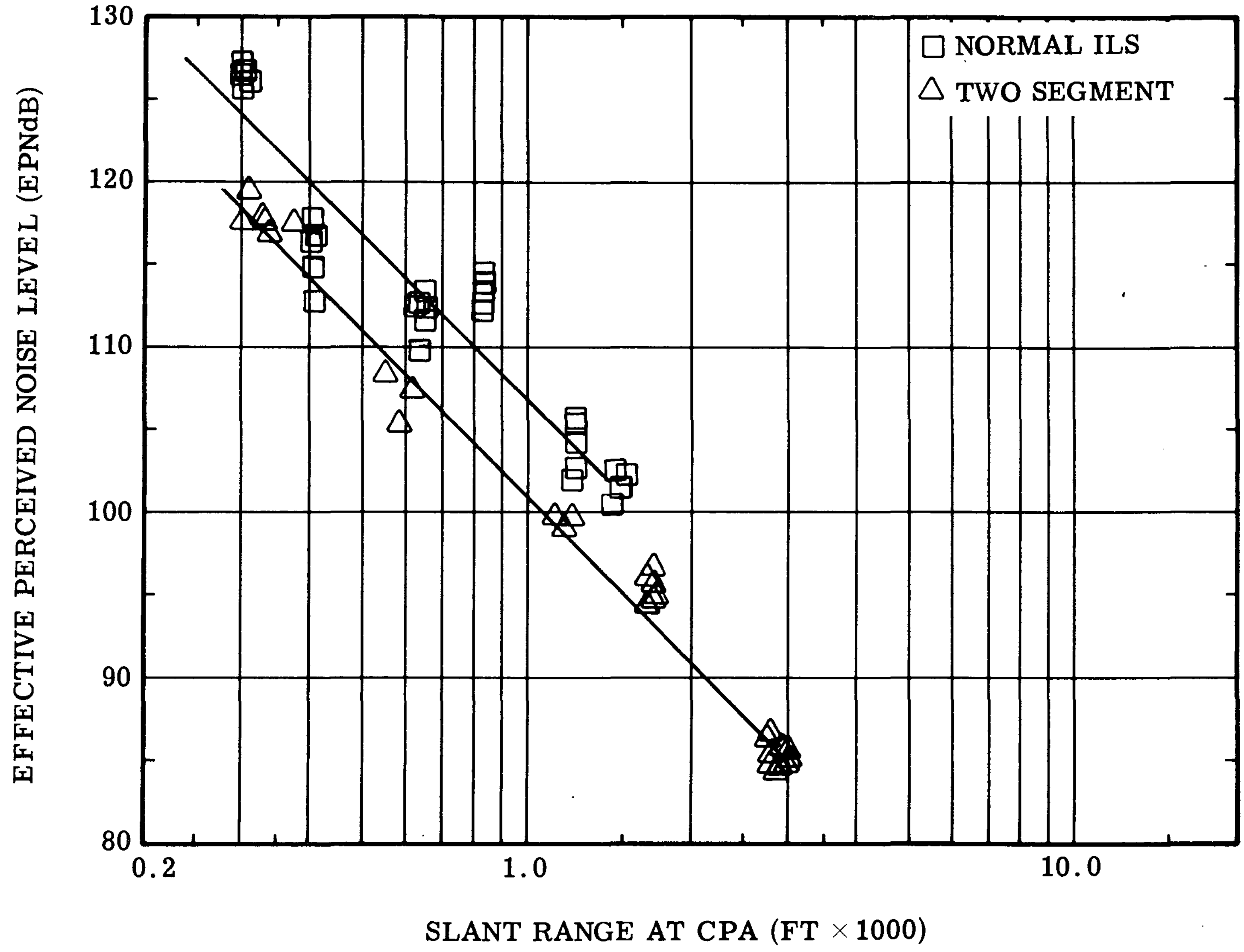


Figure A-5. Baseline EPNL Versus Slant Range on 19 August

Appendix B

DAILY ACOUSTIC RESULTS
23 - 27 AUGUST 1971

Table B-1. Guest Pilot Noise Levels - 23 August 1971

NORMAL ILS (EPNdB)

Run No.	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
2308	120.02	117.49	108.74	106.21	97.72	105.21
2309	---	---	---	---	---	---
AVG	120.02	117.49	108.74	106.21	97.72	105.21

TWO SEGMENT FOR NOISE MEASUREMENT (EPNdB)

Run No.	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
2305	112.5	106.62	97.30	95.27	86.99	---
2306	113.5	106.87	92.25	98.52	87.70	92.07
2307	109.99	106.61	98.05	96.21	---	90.87
AVG	112.00	106.81	95.75	96.70	87.42	91.4

Table B-2. Guest Pilot CPA Distance - 23 August 1971

NORMAL ILS (FT)

Run No.	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
2308	315	420	630	810	1200	1440
2309	330	315	600	930	---	---
AVG	323	368	615	870	1200	1440

TWO SEGMENT FOR NOISE MEASUREMENT (FT)

Run No.	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
2305	390	620	1260	1770	2850	2925
2306	360	600	1200	1710	2890	2970
2307	390	650	1200	1710	2870	2940
AVG	380	624	1220	1729	2870	2945

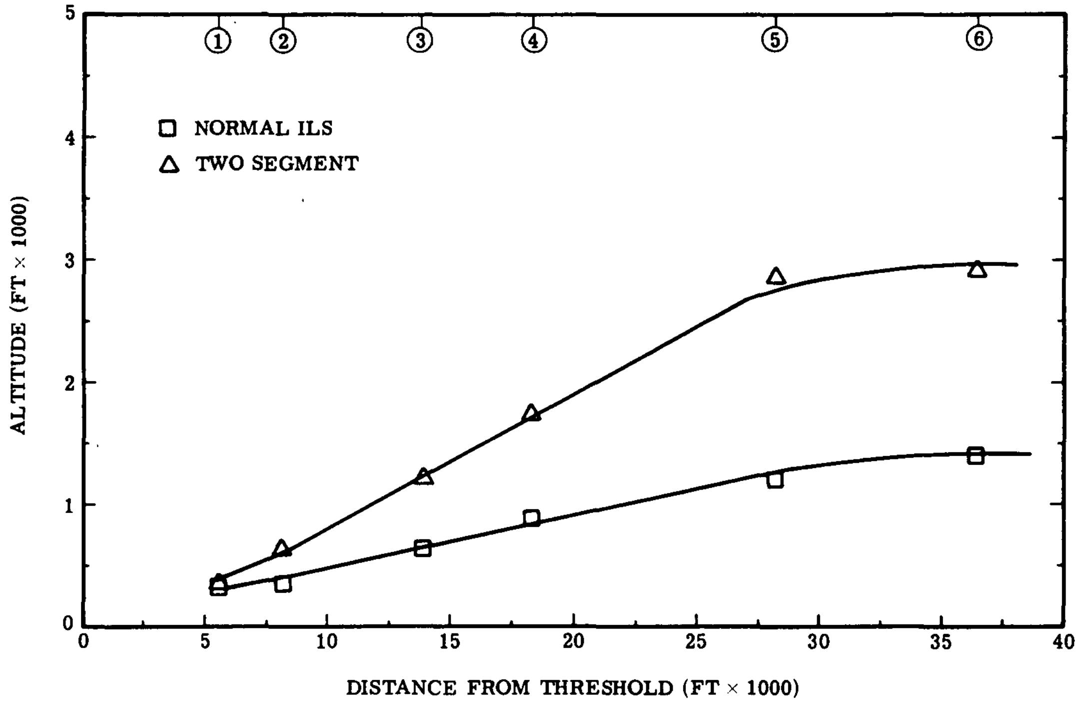


Figure B-1. Average Flight Profiles on 23 August

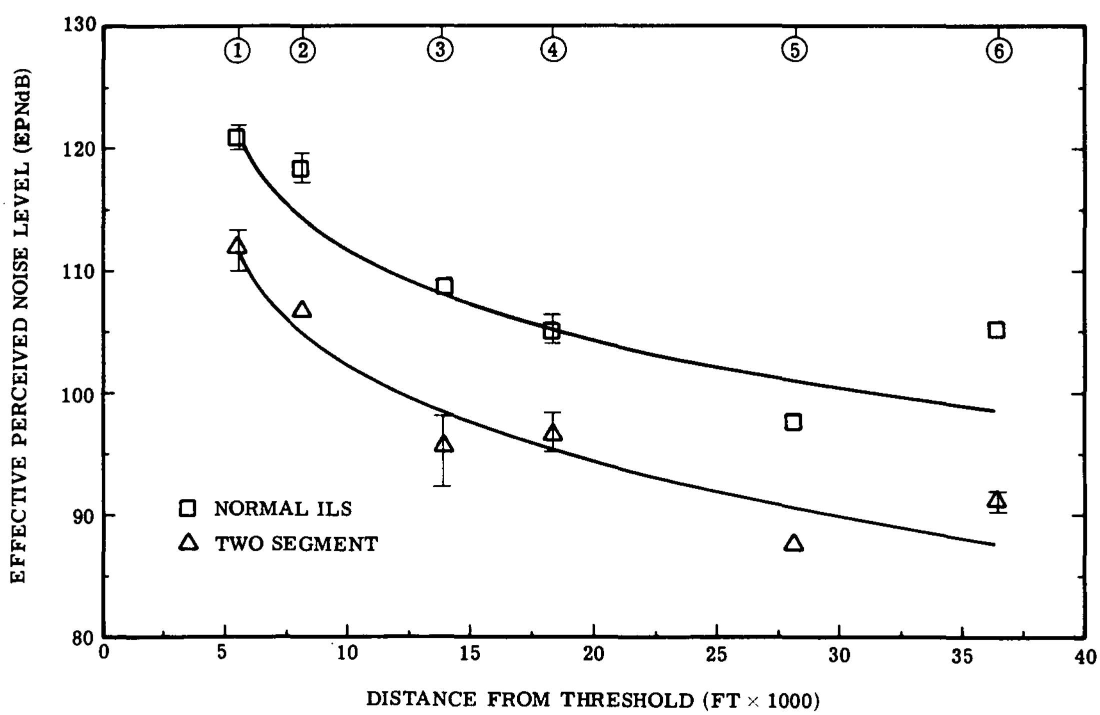


Figure B-2. EPNL Versus Distance Along Centerline on 23 August

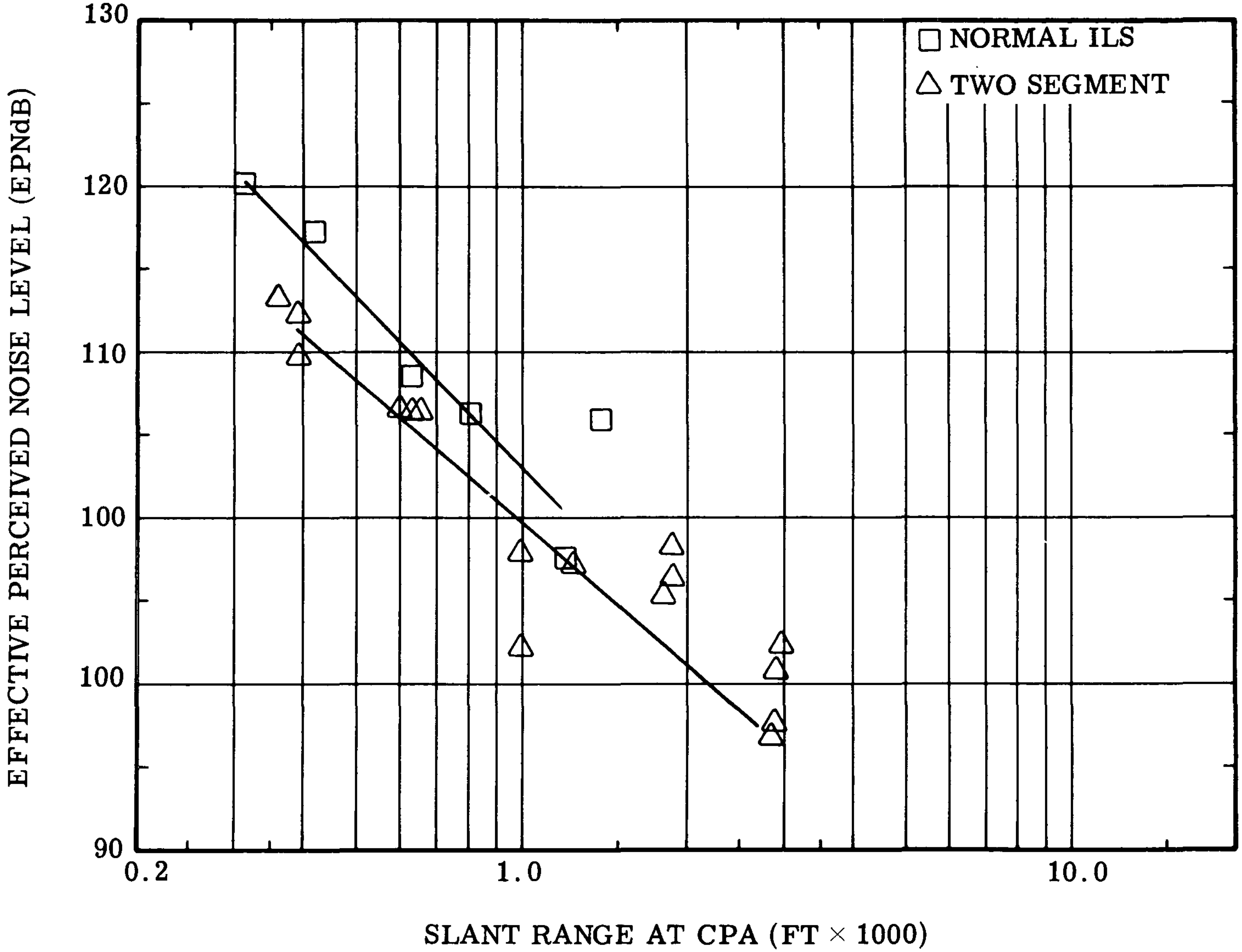


Figure B-3. EPNL Versus Slant Range on 23 August

Table B-3. Guest Pilot Noise Levels - 24 August 1971

NORMAL ILS (EPNdB)

Run No.	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
2411	119.63	116.04	110.06	111.09	101.67	103.52
2412	123.00	116.67	111.77	112.80	105.66	106.22
AVG	121.32	116.32	110.92	111.95	103.67	104.87

TWO SEGMENT FOR NOISE MEASUREMENT (EPNdB)

Run No.	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
2406	112.67	108.52	---	95.69	87.59	88.90
2407	113.07	108.55	97.07	95.34	85.60	89.22
2408	112.59	107.80	96.73	94.92	88.36	90.63
2409	112.66	108.68	96.30	---	85.45	---
2410	113.44	110.45	97.01	93.19	85.57	88.25
AVG	112.85	108.92	96.70	94.72	86.45	89.24

TWO SEGMENT FOR PRACTICE (EPNdB)

Run No.	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
2401	113.61	107.76	98.27	95.12	84.73	---
2402	114.07	108.82	98.78	95.10	85.50	---
2403	116.39	108.73	98.20	93.80	83.71	---
2404	115.51	107.93	96.65	94.93	88.35	88.79
2405	---	---	---	---	---	---
2413	117.3	111.40	98.45	94.77	88.24	89.21
2414	115.98	113.84	96.81	93.41	89.89	91.45

Table B-4. Guest Pilot Noise Levels - 24 August 1971

NORMAL ILS (FT)

Run No.	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
2411	310	390	620	800	1180	1500
2412	310	405	630	810	1200	1515
AVG	310	398	625	805	1190	1508

TWO SEGMENT FOR NOISE MEASUREMENT (FT)

Run No.	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
2406	390	630	1230	1720	2950	3090
2407	340	600	1200	1745	2970	3100
2408	350	615	1220	1750	2930	3040
2409	370	660	1245	1740	2895	3060
2410	375	600	1170	1740	2955	3090
AVG	365	621	1211	1740	2941	3075

TWO SEGMENT FOR PRACTICE (FT)

Run No.	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
2401	310	585	1185	1680	3000	3050
2402	350	580	1185	1740	2900	3050
2403	360	615	1185	1740	2820	3000
2404	360	615	1200	1740	2910	3050
2405	---	---	---	---	---	---
2413	350	600	1185	1760	2790	2920
2414	410	590	1200	1680	2970	2910

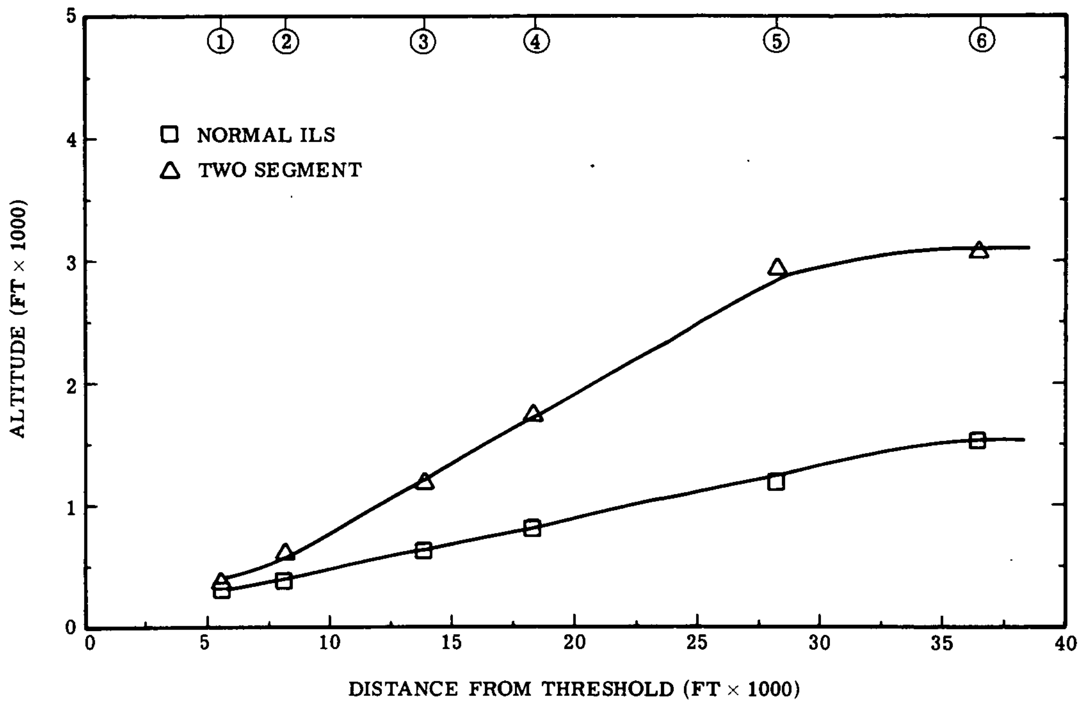


Figure B-4. Average Flight Profiles on 24 August

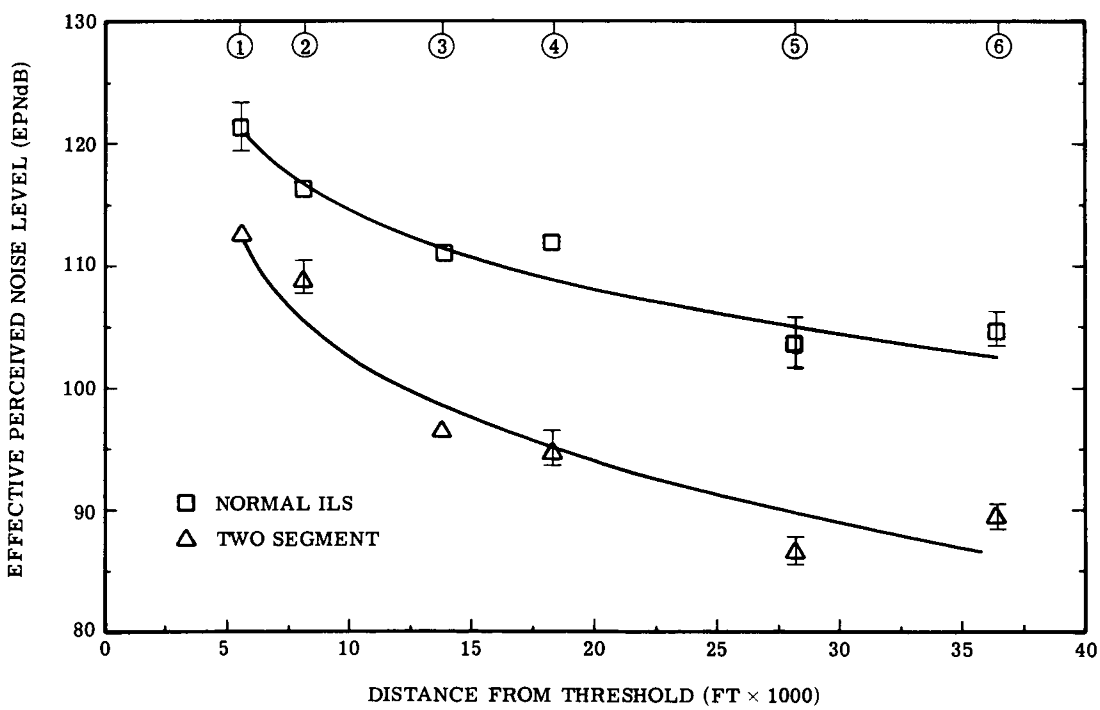


Figure B-5. EPNL Versus Distance Along Centerline on 24 August

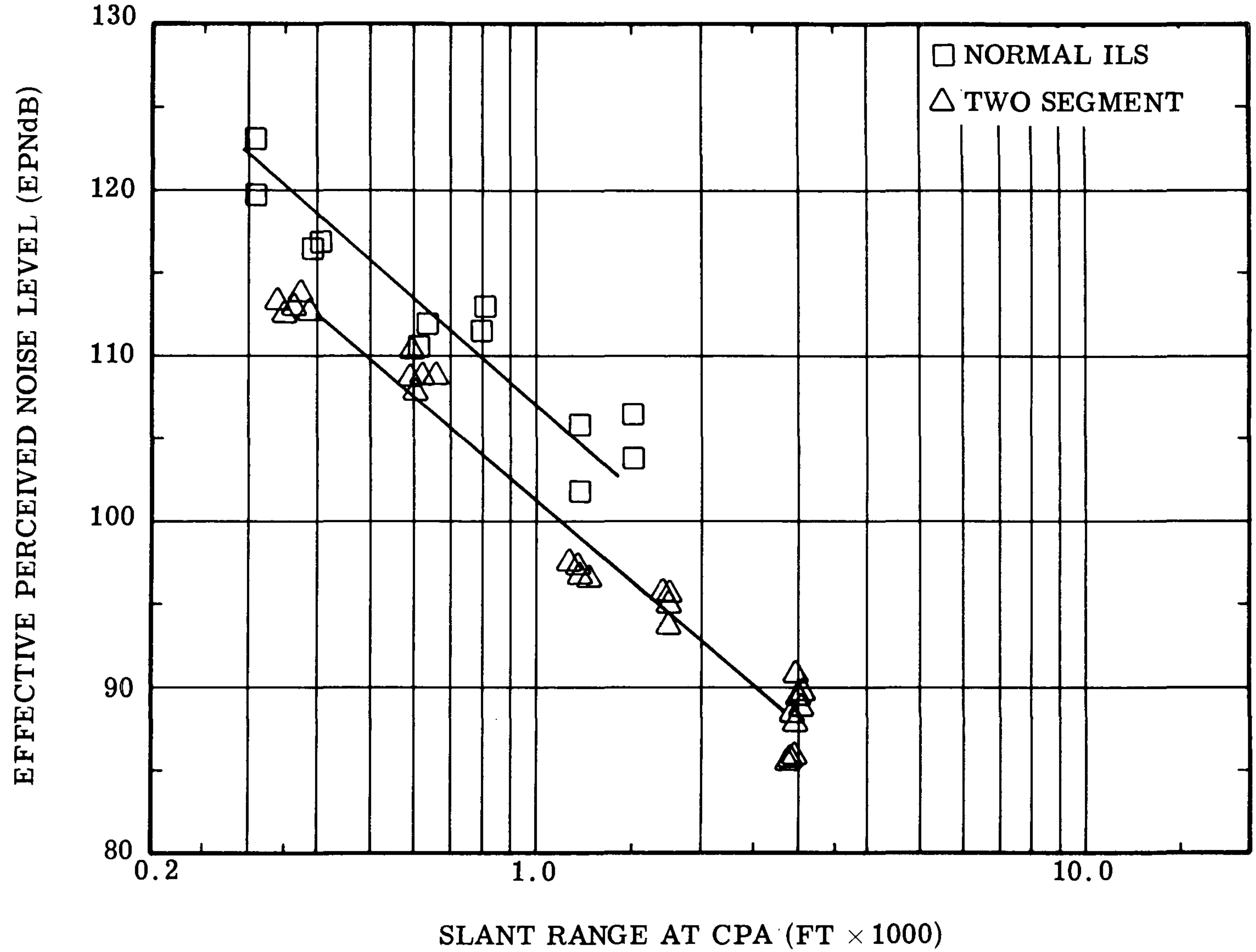


Figure B-6. EPNL Versus Slant Range on 24 August

Table B-5. Guest Pilot Noise Levels - 25 August 1971

NORMAL ILS (EPNdB)

Run No.	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
2511	119.38	117.30	113.67	113.53	106.64	106.23
2512	---	---	---	---	---	---
AVG	119.38	117.30	113.67	113.53	106.64	106.23

TWO SEGMENT FOR NOISE MEASUREMENT (EPNdB)

Run No.	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
2506	117.41	107.45	101.54	100.93	89.49	93.88
2507	118.01	109.21	99.21	100.83	91.19	90.45
2508	116.02	109.23	99.47	102.45	91.10	91.20
2509	115.65	108.68	100.70	101.42	91.20	89.23
2510	115.30	107.95	99.70	101.92	90.84	88.87
AVG	116.30	108.55	100.12	101.51	90.55	90.54

TWO SEGMENT FOR PRACTICE (EPNdB)

Run No.	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
2501	118.87	108.60	100.59	96.61	88.34	93.32
2502	120.33	108.38	99.70	99.61	89.23	90.52
2503	118.24	111.30	99.47	98.96	87.23	91.58
2504	119.36	109.84	102.21	101.52	90.27	92.48
2505	115.78	109.06	99.05	97.16	---	---
2513	112.78	106.70	98.88	97.27	90.67	93.50
2514	113.32	106.22	99.39	96.68	90.98	92.46

Table B-6. Guest Pilot CPA Distance - 25 August 1971

NORMAL ILS (FT)

Run No.	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
2511	305	400	620	810	1200	1470
2512	---	---	---	---	---	---
AVG	305	400	620	810	1200	1470

TWO SEGMENT FOR NOISE MEASUREMENT (FT)

Run No.	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
2506	375	555	1125	1650	2760	2940
2507	315	555	1120	1650	2790	2940
2508	360	570	1110	1650	2820	2970
2509	330	555	1140	1665	2800	2925
2510	375	580	1170	1680	2820	2940
AVG	351	564	1132	1658	2795	2943

TWO SEGMENT FOR PRACTICE (FT)

Run No.	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
2501	285	555	1110	1620	2810	2985
2502	290	525	1095	1590	2750	2985
2503	330	555	1095	1605	2745	2970
2504	340	555	1100	1650	2640	2890
2505	360	570	1230	2040	2850	3030
2513	435	660	1260	1785	2745	2985
2514	410	630	1185	1110	2655	2865

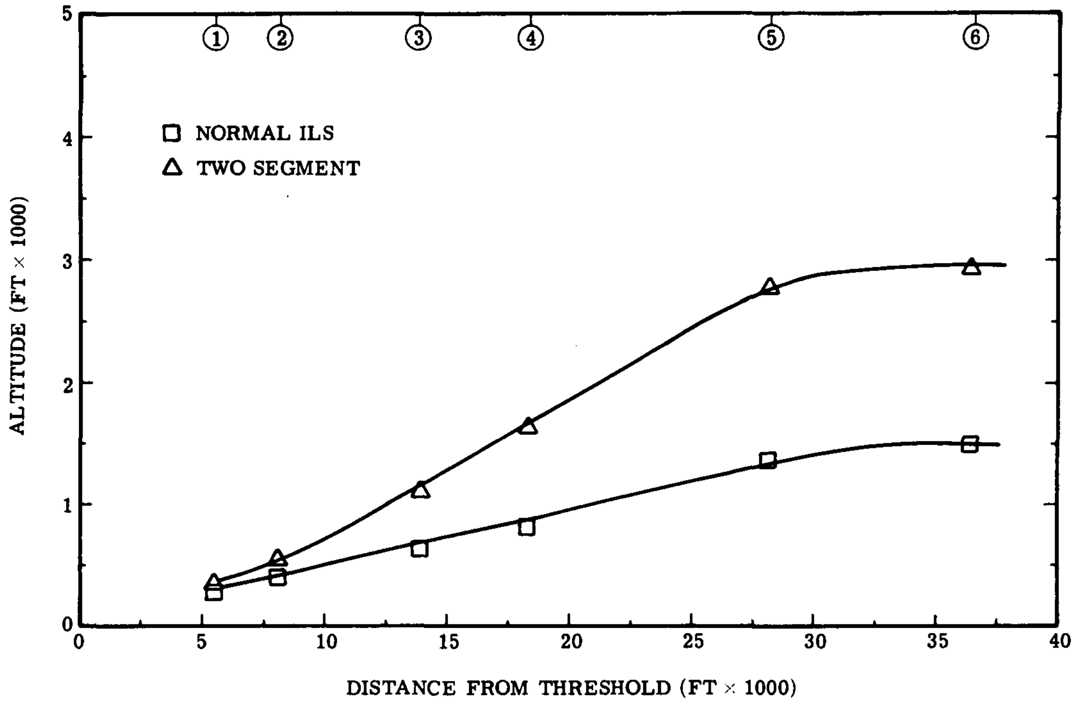


Figure B-7. Average Flight Profiles on 25 August

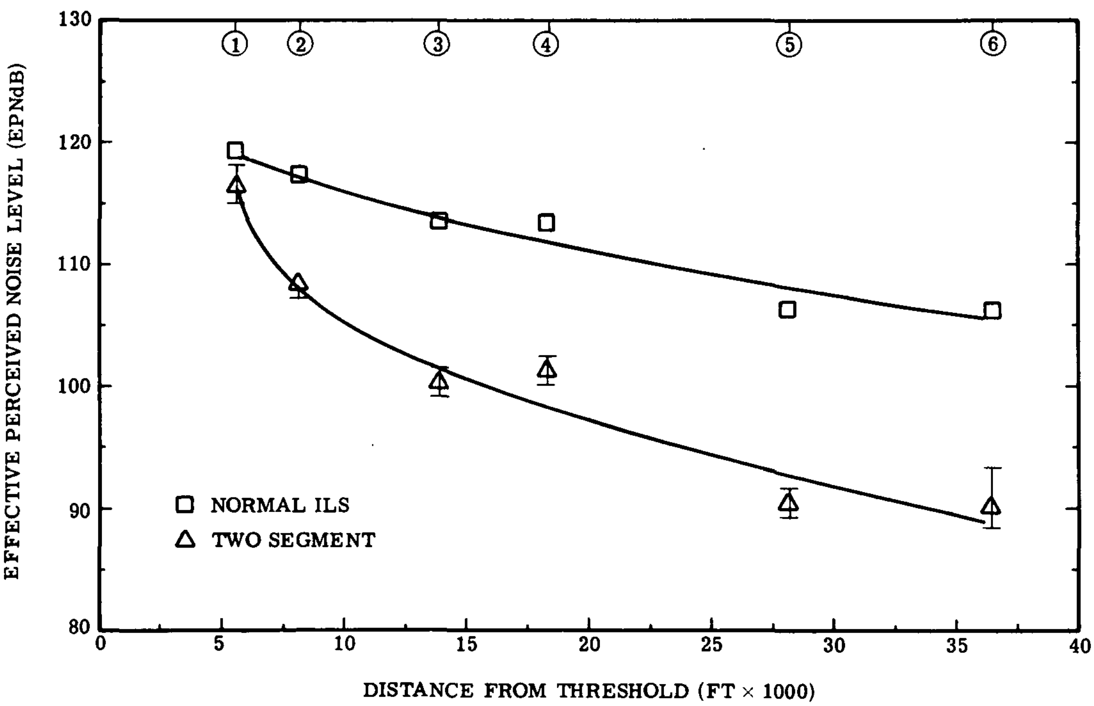


Figure B-8. EPNL Versus Distance Along Centerline on 25 August

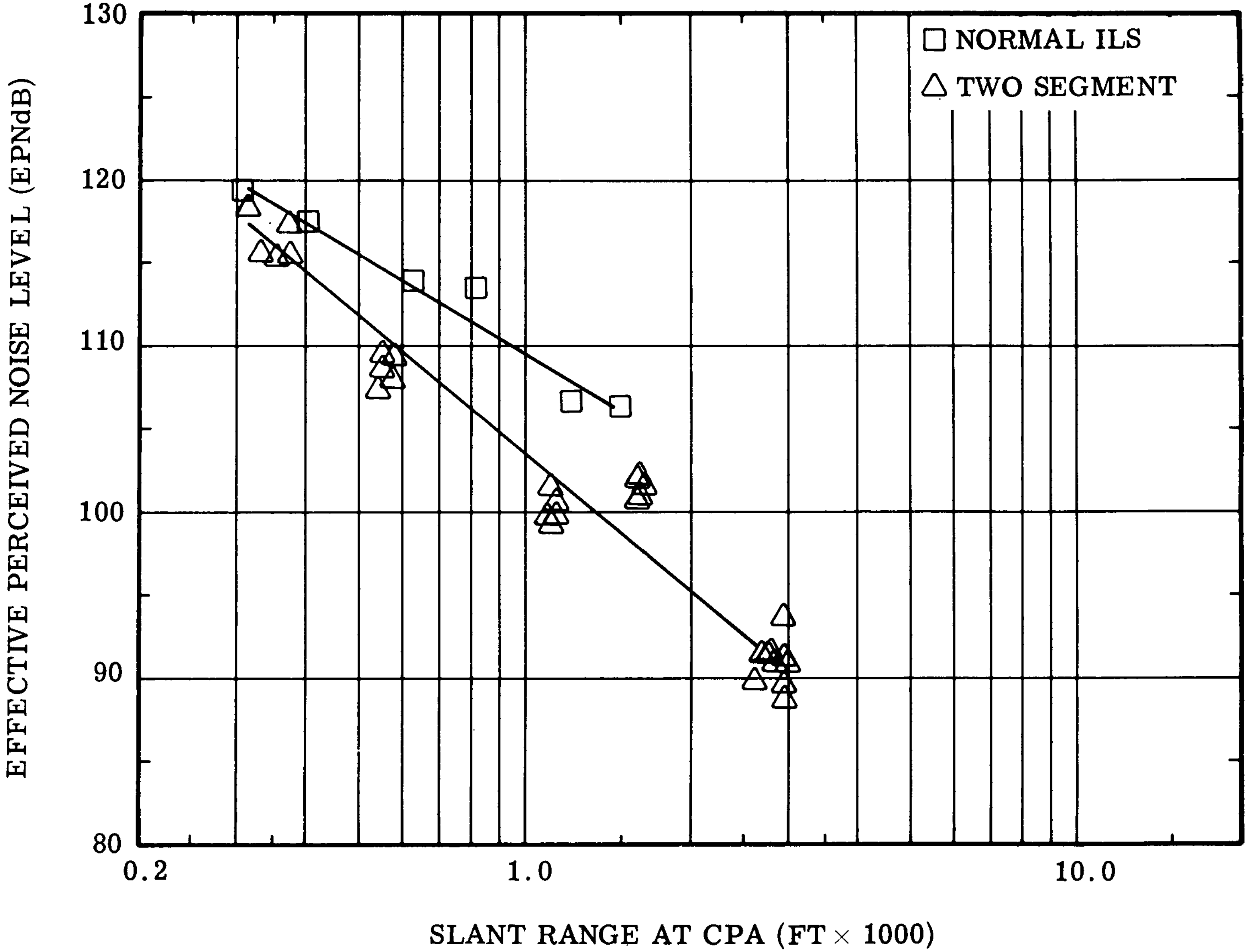


Figure B-9. EPNL Versus Slant Range on 25 August

Table B-7. Guest Pilot Noise Levels - 26 August 1971

NORMAL ILS (EPNdB)

Run No.	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
2611	118.85	114.87	113.27	114.09	107.17	101.78
2612	118.97	115.99	114.72	111.85	108.73	104.88
AVG	118.91	115.43	114.00	112.97	107.95	103.33

TWO SEGMENT FOR NOISE MEASUREMENT (EPNdB)

Run No.	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
2606	118.11	108.49	97.93	---	84.27	85.78
2607	117.49	108.22	98.80	---	83.81	86.59
2608	118.77	107.93	99.29	94.73	84.69	89.12
2609	112.65	107.53	97.59	93.70	85.16	85.87
2610	112.90	108.70	99.73	94.15	85.59	---
AVG	116.00	108.21	98.65	94.22	84.70	86.84

TWO SEGMENT FOR PRACTICE (EPNdB)

Run No.	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
2601	---	---	---	---	---	---
2602	---	107.59	96.93	95.60	83.82	86.78
2603	115.21	111.37	98.87	94.09	84.71	87.40
2604	116.07	107.70	98.41	94.35	84.09	87.37
2605	114.75	109.35	97.77	95.05	84.55	88.22

Table B-8. Guest Pilot CPA Distance - 26 August 1971

NORMAL ILS (FT)

Run No.	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
2611	340	435	680	885	1300	1600
2612	320	435	670	870	1300	1560
AVG	330	435	675	878	1300	1580

TWO SEGMENT FOR NOISE MEASUREMENT (FT)

Run No.	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
2606	360	570	1275	---	2880	3100
2607	390	600	1185	---	2910	3100
2608	370	610	1185	1725	2985	3100
2609	405	615	1275	1800	2975	3100
2610	360	600	1200	1755	2975	3100
AVG	377	599	1225	1759	2943	3100

TWO SEGMENT FOR PRACTICE (FT)

Run No.	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
2601	625	910	1510	2025	2985	2985
2602	365	600	1200	1710	2640	3100
2603	390	600	1200	1725	2940	3100
2604	400	620	1215	1740	2865	3100
2605	330	600	1200	1725	3015	3100

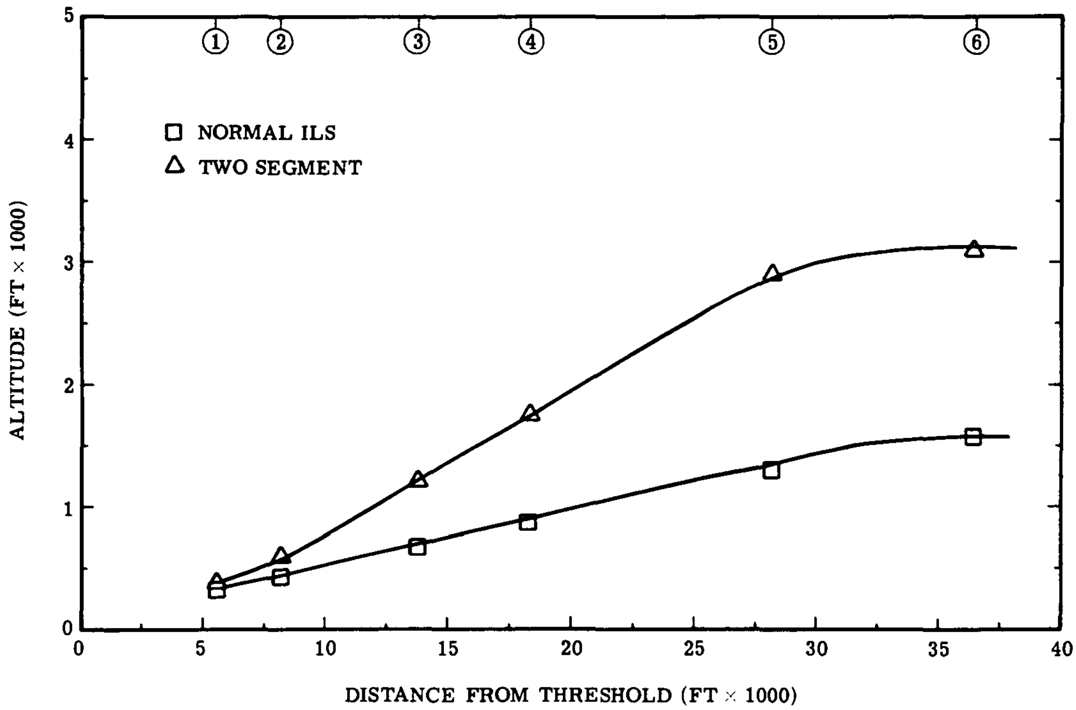


Figure B-10. Average Flight Profiles on 26 August

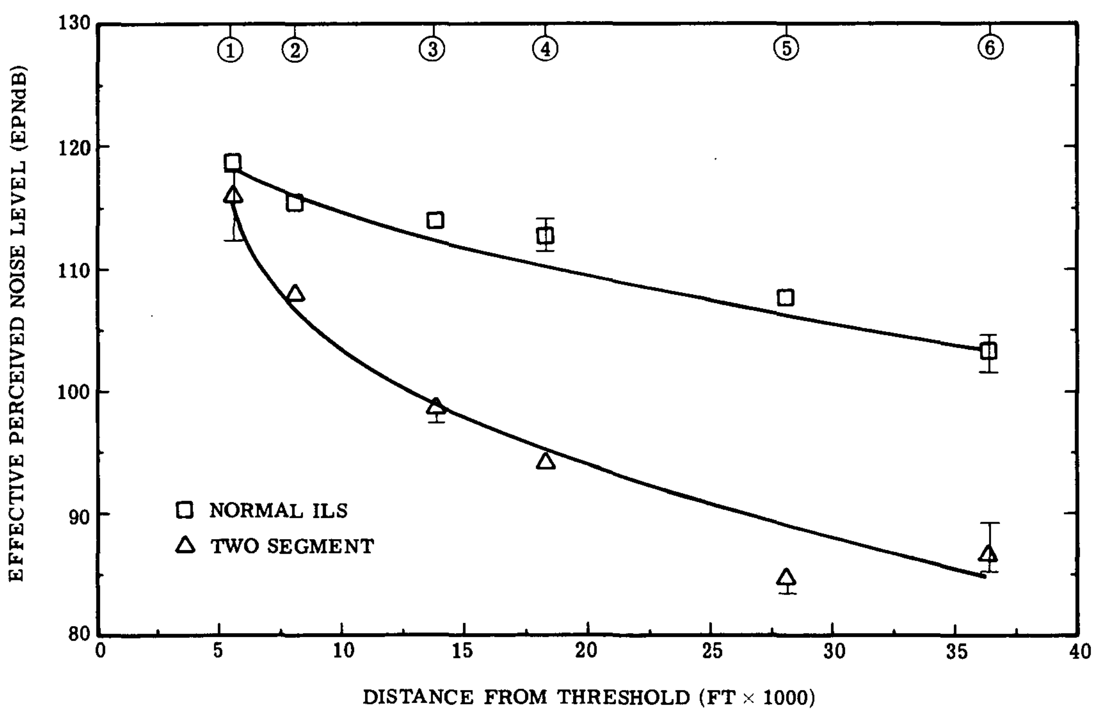


Figure B-11. EPNL Versus Distance Along Centerline on 26 August

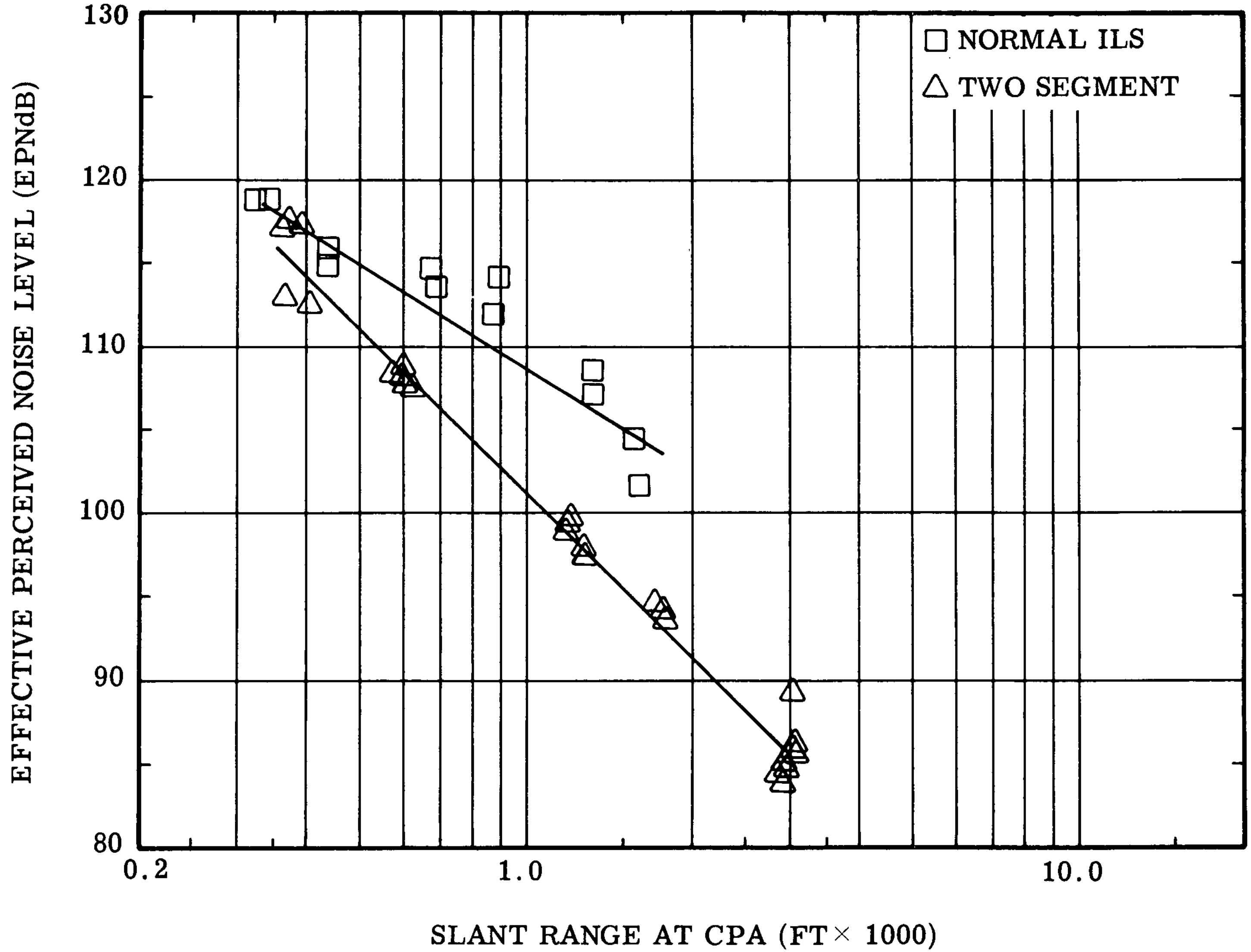


Figure B-12. EPNL Versus Slant Range on 26 August

Table B-9. Guest Pilot Noise Levels - 27 August 1971

NORMAL ILS (EPNdB)

Run No.	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
2711	120.18	118.51	114.51	112.19	106.41	100.84
2712	119.92	118.03	112.78	113.74	108.37	---
AVG	120.05	118.27	113.65	112.97	107.11	100.84

TWO SEGMENT FOR NOISE MEASUREMENT (EPNdB)

Run No.	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
2706	118.37	107.70	---	93.87	86.21	85.82
2707	115.02	108.65	---	94.53	87.21	87.63
2708	114.33	108.93	99.07	96.16	88.58	88.04
2709	116.47	108.67	97.60	94.80	---	88.58
2710	116.17	108.54	99.58	97.12	87.62	89.77
AVG	116.10	108.30	98.80	95.25	87.41	87.96

TWO SEGMENT FOR PRACTICE (EPNdB)

Run No.	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
2701	113.86	107.33	98.36	96.19	87.57	90.22
2702	114.94	108.28	99.83	94.70	87.91	88.15
2703	115.61	107.27	99.87	94.77	85.73	88.98
2704	119.11	107.01	101.16	95.59	88.02	92.62
2705	116.33	108.31	99.73	93.78	87.77	85.68

Table B-10. Guest Pilot CPA Distance - 27 August 1971

NORMAL ILS (FT)

Run No.	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
2711	340	450	690	885	1290	1560
2712	330	450	690	885	1270	1570
AVG	335	450	690	885	1280	1565

TWO SEGMENT FOR NOISE MEASUREMENT (FT)

Run No.	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
2706	350	615	---	1660	2790	3100
2707	340	630	---	1695	2640	3100
2708	345	615	1155	1680	2800	3015
2709	360	585	1215	1650	2850	3100
2710	360	615	1170	1680	2770	3100
AVG	351	613	1181	1673	2770	3083

TWO SEGMENT FOR PRACTICE (FT)

Run No.	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
2701	370	630	1200	1680	2700	2985
2702	380	645	1140	1770	2810	3100
2703	380	650	1160	1710	2810	3100
2704	400	660	1215	1700	2760	3015
2705	330	585	1130	1785	3100	3100

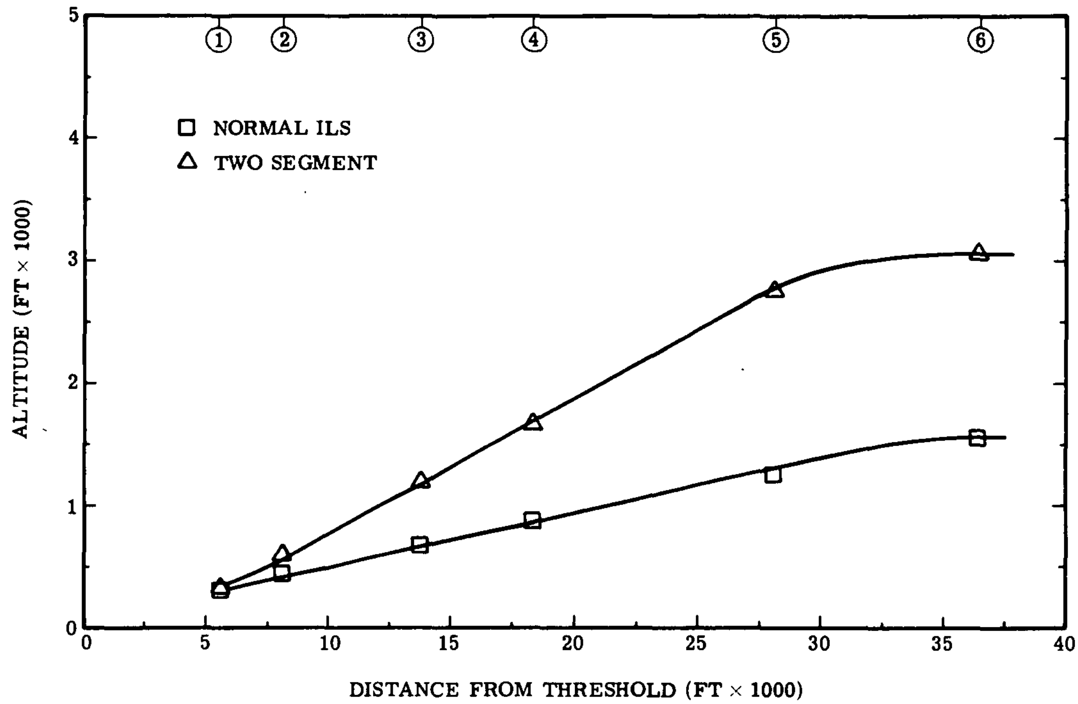


Figure B-13. Average Flight Profiles on 27 August

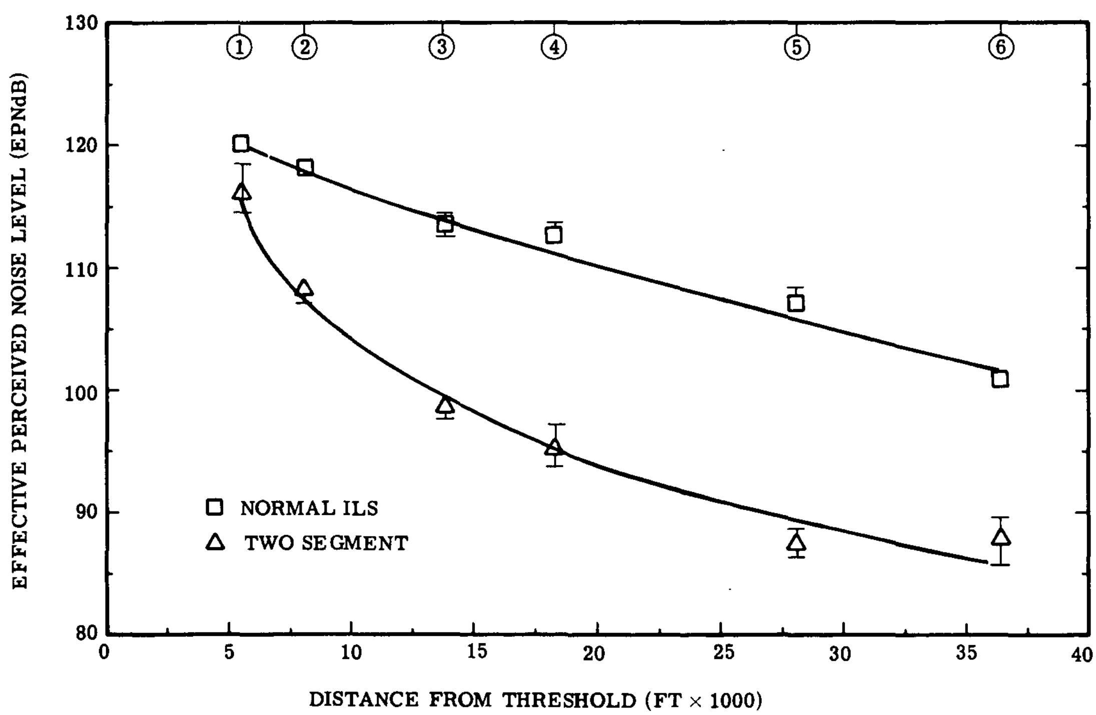


Figure B-14. EPNL Versus Distance Along Centerline on 27 August

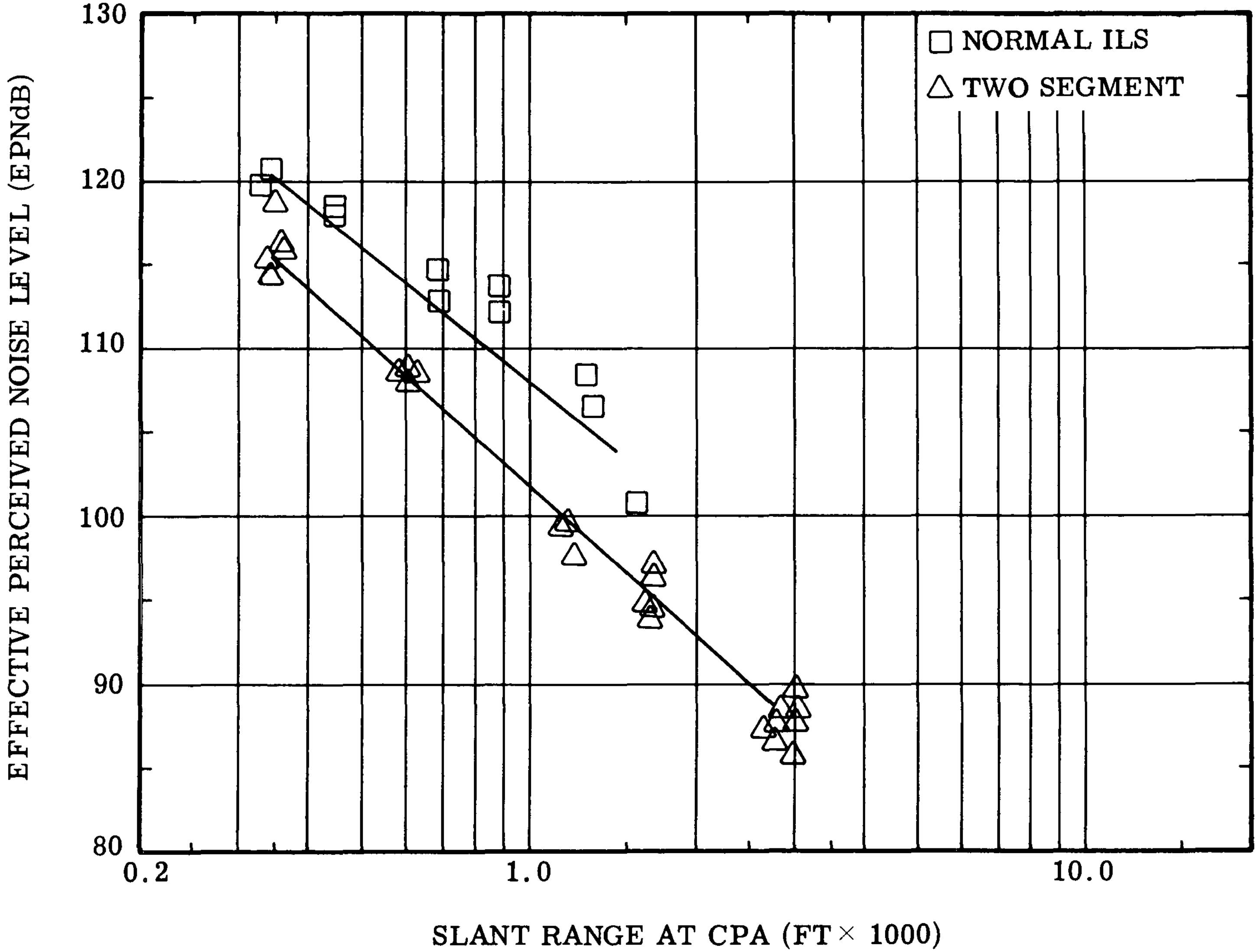


Figure B-15. EPNL Versus Slant Range on 27 August

Appendix C

DAILY ACOUSTIC RESULTS
31 AUGUST - 3 SEPTEMBER 1971

Table C-1. Guest Pilot Noise Levels - 31 August 1971

NORMAL ILS (EPNdB)

Run No.	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
3111	123.17	117.31	115.42	112.76	108.28	104.62
3112	123.67	117.56	111.34	111.45	105.65	104.82
AVG	123.42	117.48	113.70	112.11	106.97	104.72

TWO SEGMENT FOR NOISE MEASUREMENT (EPNdB)

Run No.	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
3106	119.84	111.38	---	98.70	89.99	93.48
3107	121.41	109.44	101.32	97.06	---	95.00
3108	120.64	109.69	102.46	98.14	---	92.94
3109	121.07	109.98	103.00	98.09	91.68	91.95
3110	120.84	108.52	102.48	97.87	91.84	93.01
AVG	120.5	109.9	102.50	97.8	91.1	93.45

TWO SEGMENT FOR PRACTICE (EPNdB)

Run No.	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
3101	119.49	115.80	101.73	97.71	---	92.27
3102	113.80	109.14	101.05	97.86	90.63	89.93
3103	120.92	110.93	101.23	98.33	92.47	93.68
3104	122.16	110.10	101.56	96.78	89.33	94.22
3105	120.09	108.14	---	90.28	90.03	92.03

Table C-2. Guest Pilot CPA Distance - 31 August 1971

NORMAL ILS (FT)

Run No.	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
3111	300	450	665	870	1265	1505
3112	305	415	690	845	1260	1515
AVG	303	433	678	858	1263	1510

TWO SEGMENT FOR NOISE MEASUREMENT (FT)

Run No.	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
3106	350	555	1080	1590	2745	2960
3107	330	525	1110	1560	2700	2925
3108	330	510	1135	1650	2715	2935
3109	300	515	1110	1600	2790	2925
3110	320	560	1140	1615	2780	2930
AVG	326	533	1113	1605	2750	2935

TWO SEGMENT FOR PRACTICE (FT)

Run No.	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
3101	435	645	1180	1675	2760	2960
3102	350	630	1170	1630	2700	2935
3103	330	570	1110	1620	2720	2880
3104	340	545	1135	1615	2730	2930
3105	325	560	1140	1590	2820	2870

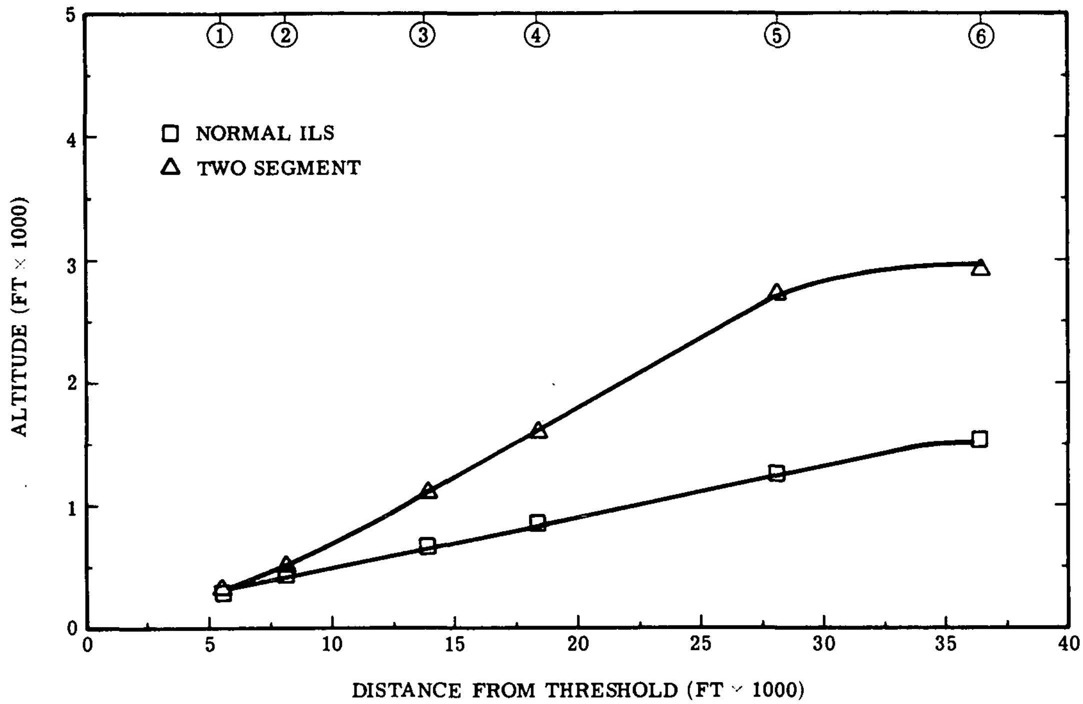


Figure C-1. Average Flight Profiles on 31 August

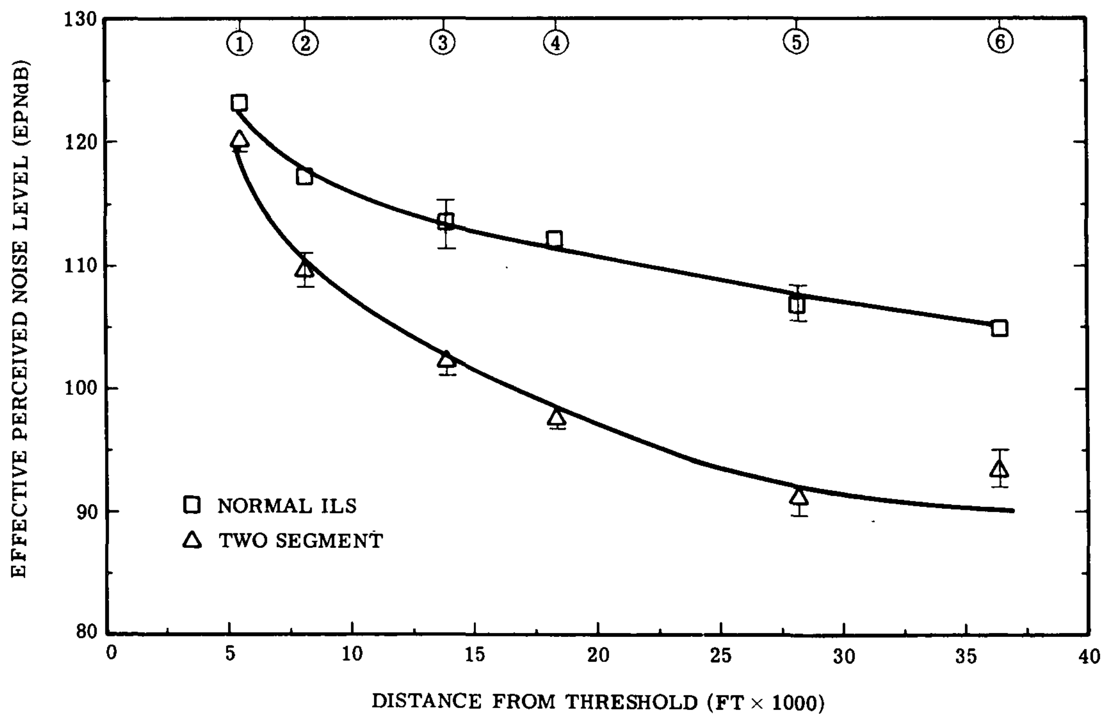


Figure C-2. EPNL Versus Distance Along Centerline on 31 August

2

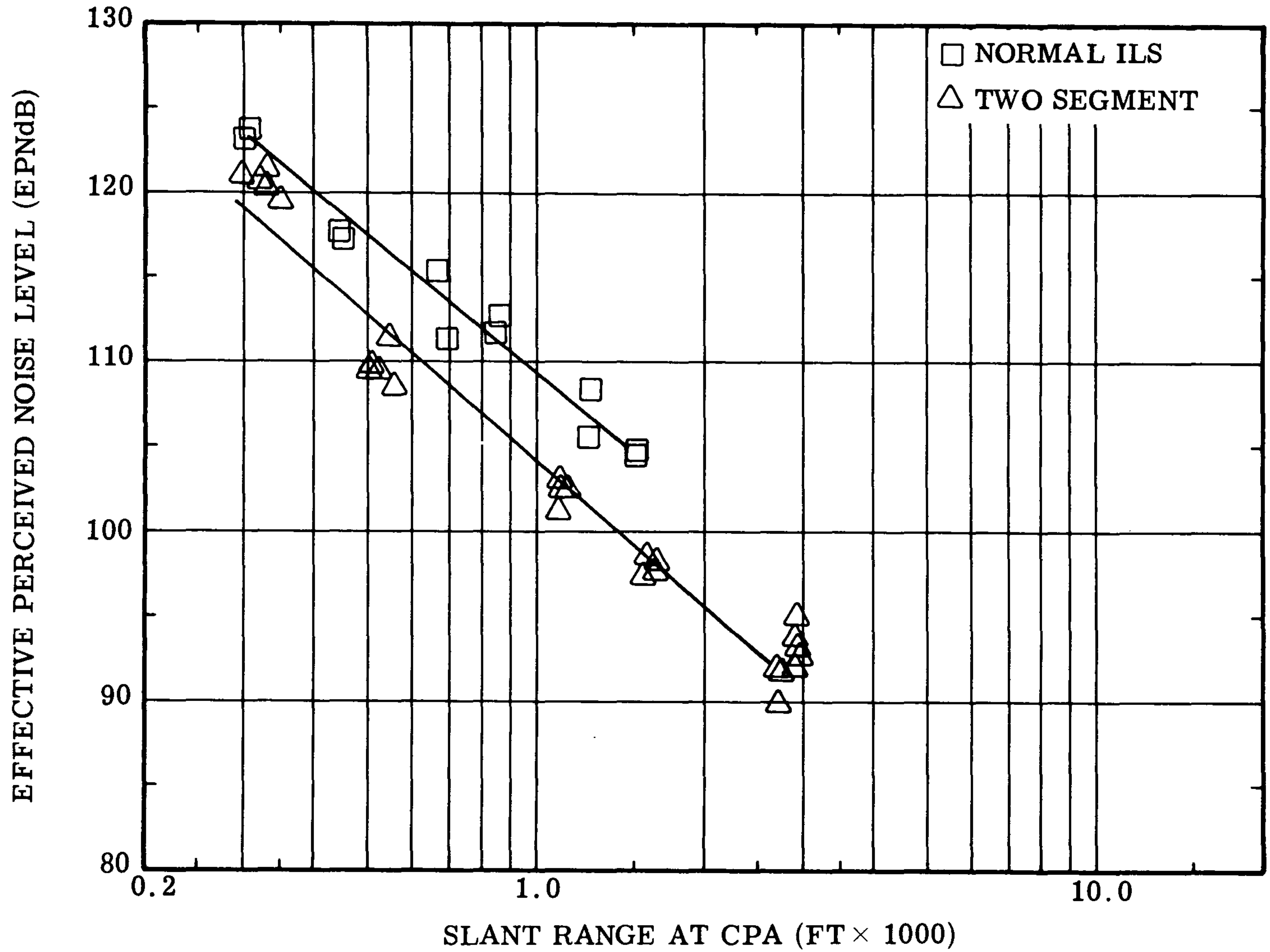


Figure C-3. EPNL Versus Slant Range on 31 August

Table C-3. Guest Pilot Noise Levels - 1 September 1971

NORMAL ILS (EPNdB)

Run No.	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
111	122.22	115.48	116.74	113.98	103.36	97.47
112	122.98	---	115.93	112.96	108.92	104.75
AVG	122.6	115.48	116.45	113.47	106.14	101.11

TWO SEGMENT FOR NOISE MEASUREMENT (EPNdB)

Run No.	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
106	115.59	107.32	101.74	97.67	91.71	90.52
107	114.10	107.52	101.52	97.84	90.84	89.96
108	115.06	---	---	---	89.91	---
109	115.85	108.16	101.65	97.37	---	88.37
110	117.80	108.22	102.25	98.38	91.86	90.99
AVG	115.6	107.85	101.70	97.8	91.10	89.85

TWO SEGMENT FOR PRACTICE (EPNdB)

Run No.	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
101	---	108.41	100.48	98.43	90.97	---
102	120.66	107.97	101.06	96.61	87.81	93.53
103	116.27	108.23	100.61	96.52	89.78	91.72
104	118.95	107.91	101.07	96.50	90.01	90.14
105	114.48	107.48	99.74	95.80	89.00	91.24

Table C-4. Guest Pilot CPA Distance - 1 September 1971

NORMAL ILS (FT)

Run No.	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
111	330	420	660	865	1265	1505
112	330	430	660	855	1290	1560
AVG	330	425	660	860	1278	1533

TWO SEGMENT FOR NOISE MEASUREMENT (FT)

Run No.	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
106	390	600	1200	1710	2830	2970
107	390	610	1185	1685	2770	3055
108	345	645	1260	1770	2855	3060
109	320	560	1190	1700	2840	2990
110	320	540	1265	1680	2900	2980
AVG	353	591	1220	1708	2838	2999

TWO SEGMENT FOR PRACTICE (FT)

Run No.	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
101	355	600	1200	1660	2750	3040
102	360	600	1200	1655	2855	3100
103	375	660	1200	1710	2850	2960
104	360	660	1235	1720	2820	2880
105	355	710	1380	2040	3060	3060

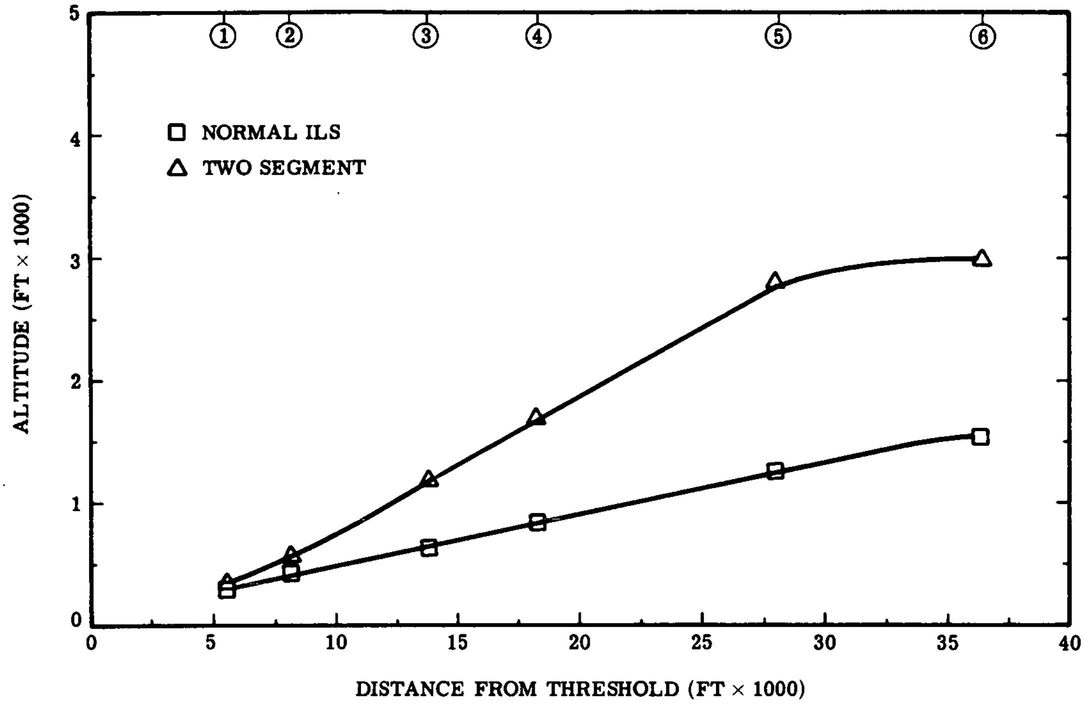


Figure C-4. Average Flight Profiles on 1 September

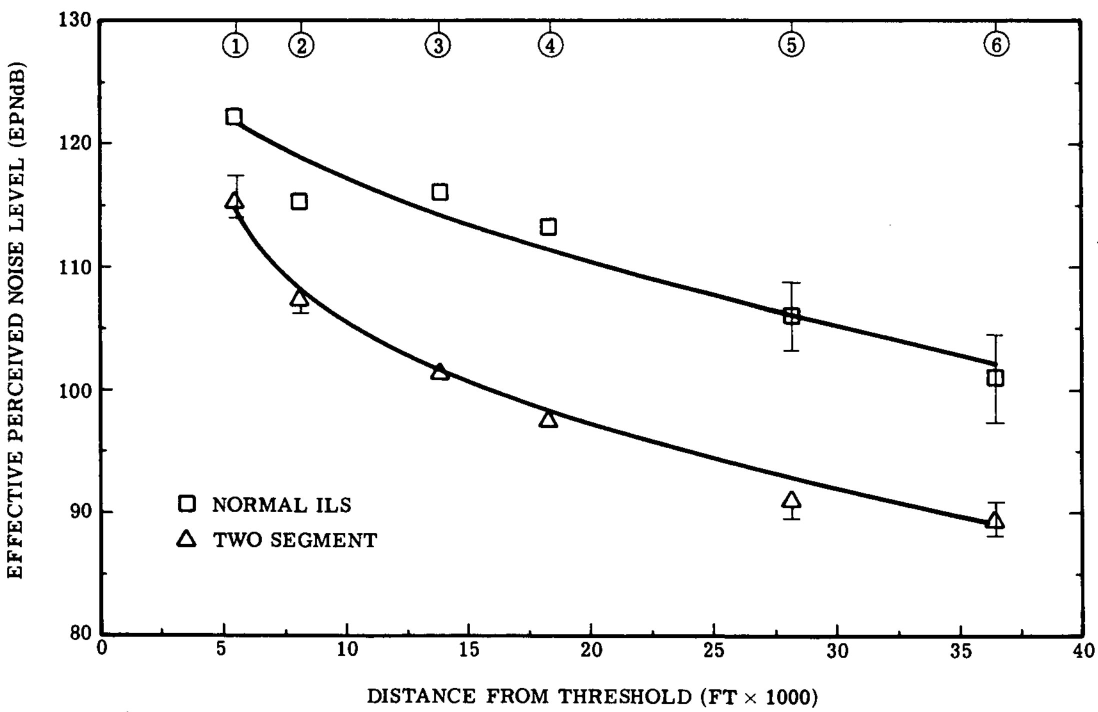


Figure C-5. EPNL Versus Distance Along Centerline on 1 September

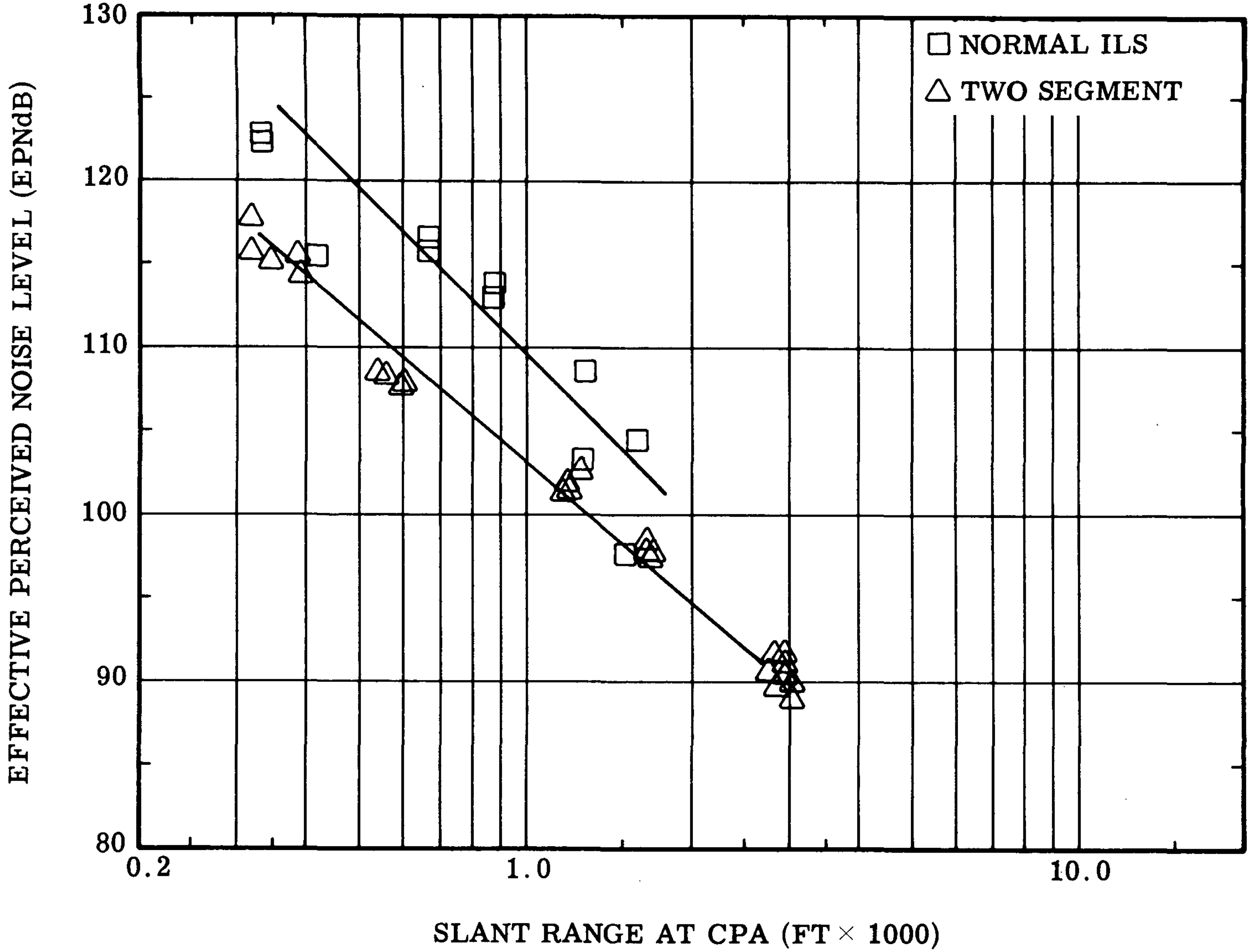


Figure C-6. EPNL Versus Slant Range on 1 September

Table C-5. Guest Pilot Noise Levels - 2 September 1971

NORMAL ILS (EPNdB)

Run No.	Site 1	Site 3	Site 6	Site 7	Site 8	Site 9
211	---	---	---	---	---	---
212	122.35	115.20	101.13	111.70	99.67	96.21
AVG	122.35	115.20	101.13	111.70	99.67	96.21

TWO SEGMENT FOR NOISE MEASUREMENT (EPNdB)

Run No.	Site 1	Site 3	Site 6	Site 7	Site 8	Site 9
206	120.43	100.95	88.76	107.22	90.24	85.87
207	121.90	102.00	90.16	110.30	92.59	87.53
208	117.92	100.45	88.90	106.66	91.95	89.22
209	121.55	101.60	91.82	110.85	92.57	---
210	122.21	102.54	89.94	109.52	93.29	89.05
AVG	120.80	101.60	89.85	108.9	92.2	87.9

TWO SEGMENT FOR PRACTICE (EPNdB)

Run No.	Site 1	Site 3	Site 6	Site 7	Site 8	Site 9
201	---	---	---	---	---	---
202	123.42	102.33	88.91	111.01	91.98	89.30
203	120.91	101.65	92.81	111.35	90.27	88.98
204	121.45	102.48	91.05	113.84	92.05	89.12
205	122.36	100.56	89.67	106.77	90.21	86.08

Table C-6. Guest Pilot CPA Distance - 2 September 1971

NORMAL ILS (FT)

Run No.	Site 1	Site 3	Site 6	Site 7	Site 8	Site 9
211	---	---	---	---	---	---
212	330	680	1610	1135	1975	3595
AVG	330	680	1610	1135	1975	3595

TWO SEGMENT FOR NOISE MEASUREMENT (FT)

Run No.	Site 1	Site 3	Site 6	Site 7	Site 8	Site 9
206	300	1080	2965	1130	2158	4370
207	320	1115	2900	1135	2200	4375
208	330	1140	3035	1135	2205	4460
209	360	1110	3100	1140	2175	4460
210	350	1080	3030	1137	2165	4440
AVG	332	1105	3004	1135	2181	4420

TWO SEGMENT FOR PRACTICE (FT)

Run No.	Site 1	Site 3	Site 6	Site 7	Site 8	Site 9
201	---	---	---	---	---	---
202	330	1080	2975	1135	2158	4440
203	330	1060	3100	1135	2158	4460
204	345	1050	3035	1140	2158	4460
205	315	1095	2910	1130	2165	4435

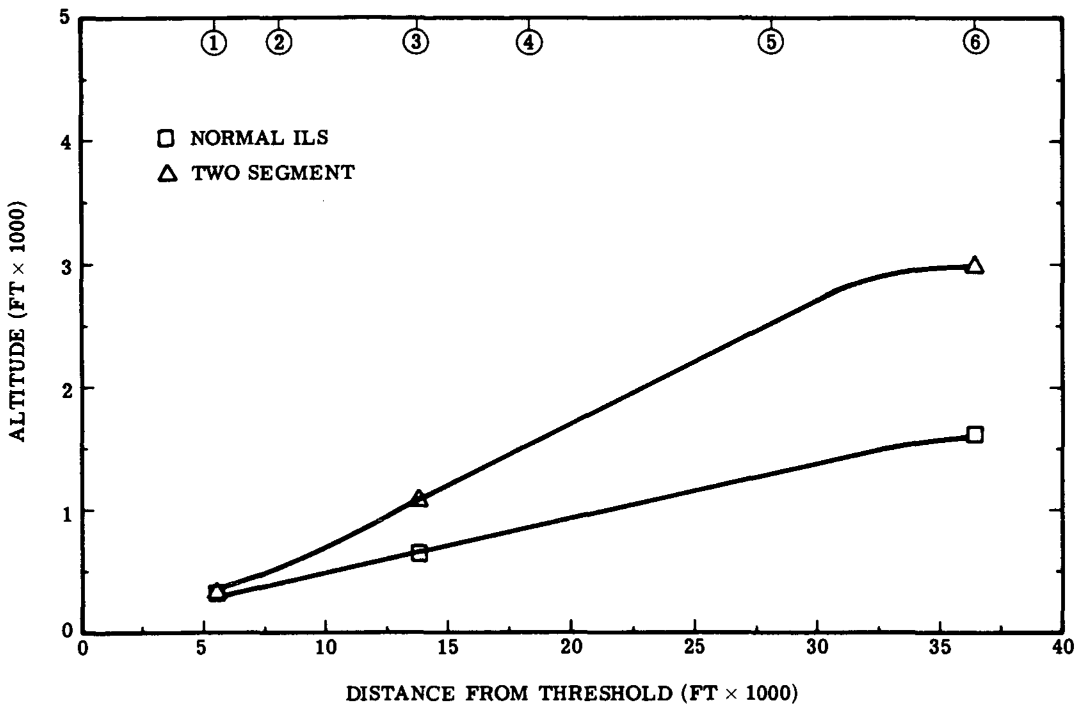


Figure C-7. Average Flight Profiles on 2 September

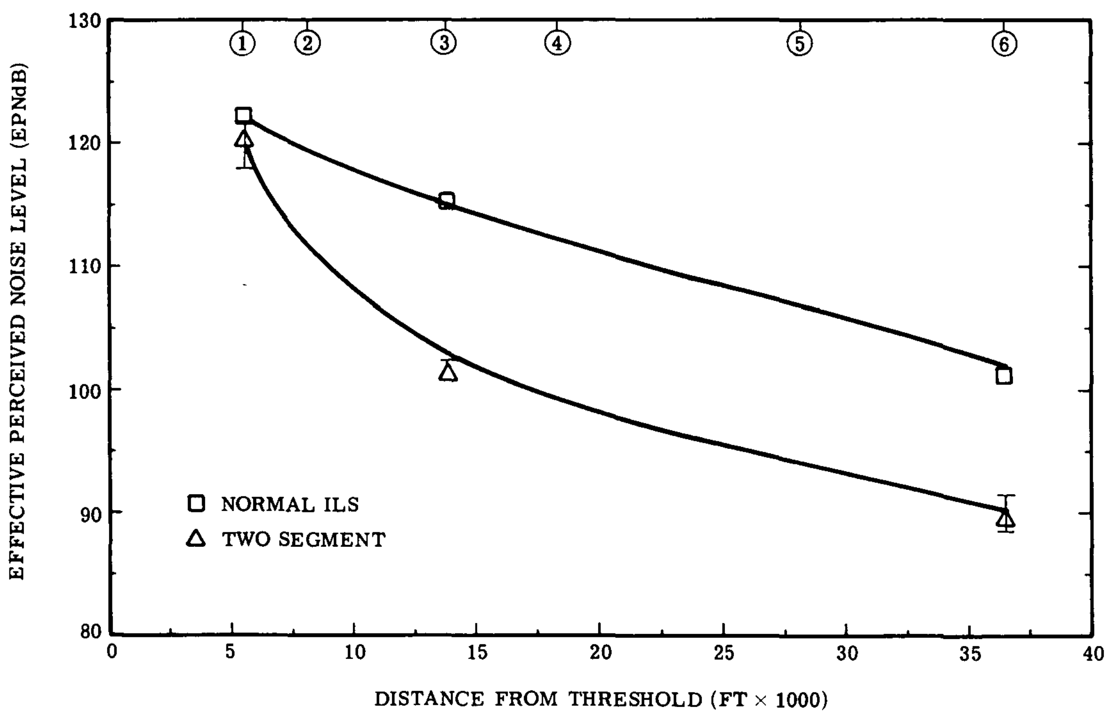


Figure C-8. EPNL Versus Distance Along Centerline on 2 September

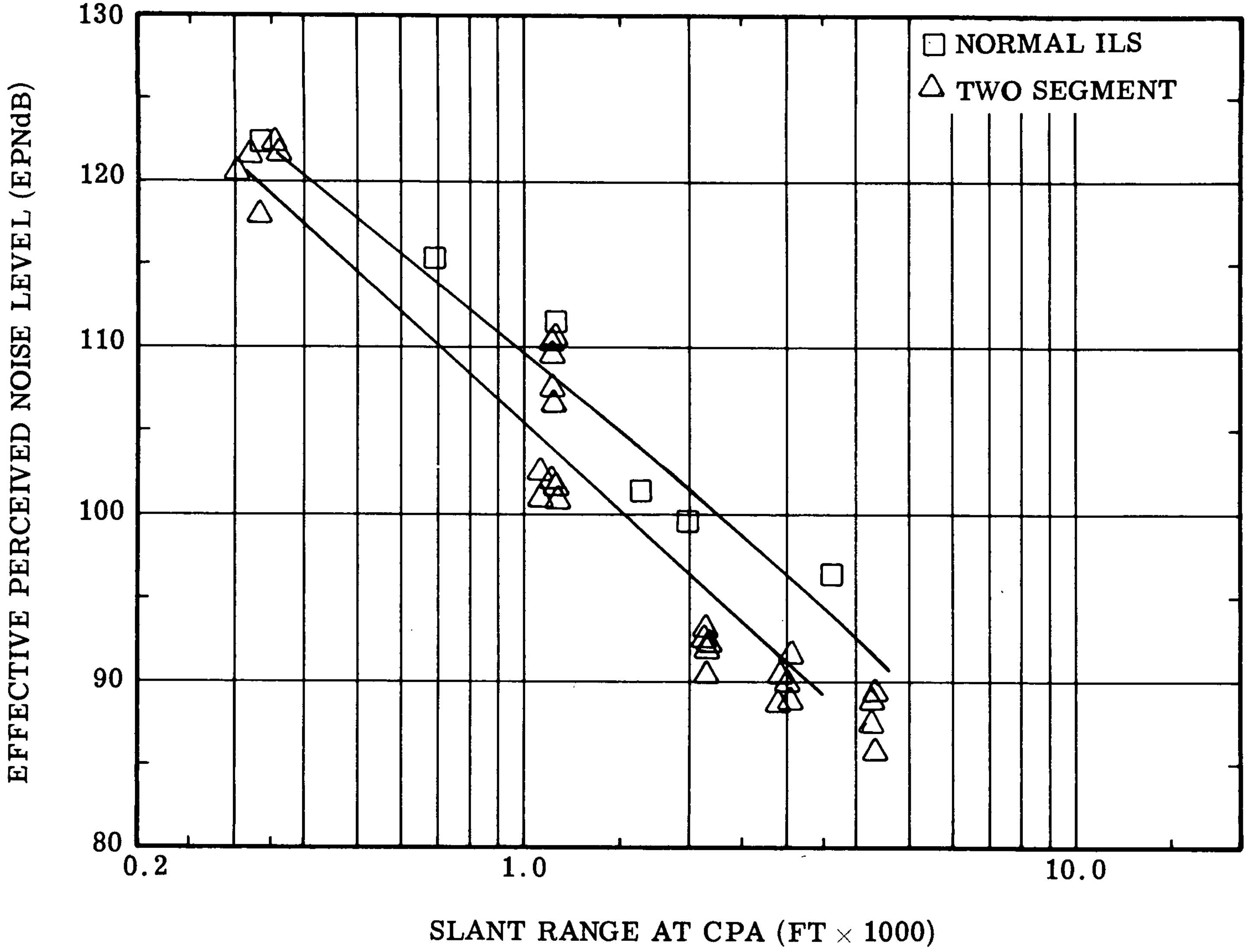


Figure C-9. EPNL Versus Slant Range on 2 September

Table C-7. Guest Pilot Noise Levels - 3 September 1971

NORMAL ILS (EPNdB)

Run No.	Site 1	Site 3	Site 6	Site 7	Site 8	Site 9
311	122.3	114.34	108.1	112.34	100.11	99.96
312	---	---	---	---	---	---
AVG	122.3	114.34	108.1	112.34	100.11	99.96

TWO SEGMENT FOR NOISE MEASUREMENT (EPNdB)

Run No.	Site 1	Site 3	Site 6	Site 7	Site 8	Site 9
306	121.34	103.77	88.71	110.68	95.61	86.27
307	121.94	102.23	93.10	109.02	94.78	88.11
308	121.98	102.70	89.35	109.21	94.15	86.98
309	122.21	104.25	---	110.02	94.17	86.17
310	121.52	103.10	89.27	110.67	94.52	84.32
AVG	121.6	103.4	90.25	109.9	94.6	86.3

TWO SEGMENT FOR PRACTICE (EPNdB)

Run No.	Site 1	Site 3	Site 6	Site 7	Site 8	Site 9
301	123.26	101.62	87.78	109.45	95.10	84.73
302	117.45	101.01	87.55	111.65	94.16	86.92
303	118.05	101.03	90.99	111.73	94.98	90.55
304	115.75	101.61	87.66	109.44	93.65	---
305	122.36	99.41	88.55	108.84	91.39	85.65

ILS (40^{0} FLAPS) (EPNdB)

Run No.	Site 1	Site 3	Site 6	Site 7	Site 8	Site 9
313	117.52	111.62	101.95	---	98.37	96.70
314	116.55	112.55	103.50	105.93	97.71	97.25
AVG	117.04	112.09	102.73	105.93	98.04	96.98

COMMERCIAL FLIGHT (EPNdB)

Run No.	Site 1	Site 3	Site 6	Site 7	Site 8	Site 9
315	115.90	104.77	---	104.17	93.17	---

Table C-8. Guest Pilot CPA Distance - 3 September 1971

NORMAL ILS (FT)

Run No.	Site 1	Site 3	Site 6	Site 7	Site 8	Site 9
311	315	690	1485	1135	1975	3550
312	---	---	---	---	---	---
AVG	315	690	1485	1135	1975	3550

TWO SEGMENT FOR NOISE MEASUREMENT (FT)

Run No.	Site 1	Site 3	Site 6	Site 7	Site 8	Site 9
306	360	1110	2990	1140	2170	4420
307	330	1170	3030	1135	2210	4430
308	390	1110	3060	1145	2165	4460
309	360	1120	3030	1137	2160	4440
310	390	1115	3100	1145	2170	4460
AVG	367	1125	3042	1141	2173	4450

TWO SEGMENT FOR PRACTICE (FT)

Run No.	Site 1	Site 3	Site 6	Site 7	Site 8	Site 9
301	320	1080	3075	1135	2158	4460
302	330	1095	3100	1135	2160	4460
303	330	1135	2950	1135	2170	4380
304	350	1110	2940	1135	2165	4385
305	330	1115	2965	1130	2170	4430

ILS (40^{o} FLAPS) (FT)

Run No.	Site 1	Site 3	Site 6	Site 7	Site 8	Site 9
313	320	680	1330	1135	1970	3530
314	300	675	1645	1135	1975	3590
AVG	310	678	1488	1135	1973	3560

COMMERCIAL FLIGHT (FT)

Run No.	Site 1	Site 3	Site 6	Site 7	Site 8	Site 9
315	290	690	1680	1135	1975	3565

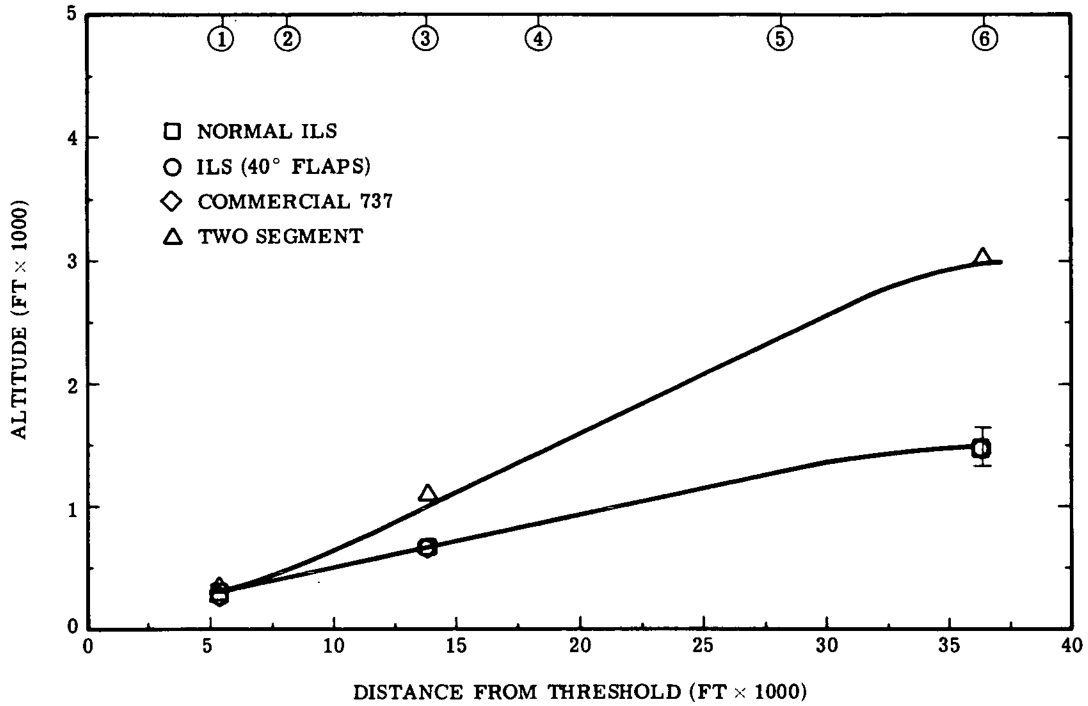


Figure C-10. Average Flight Profiles on 3 September

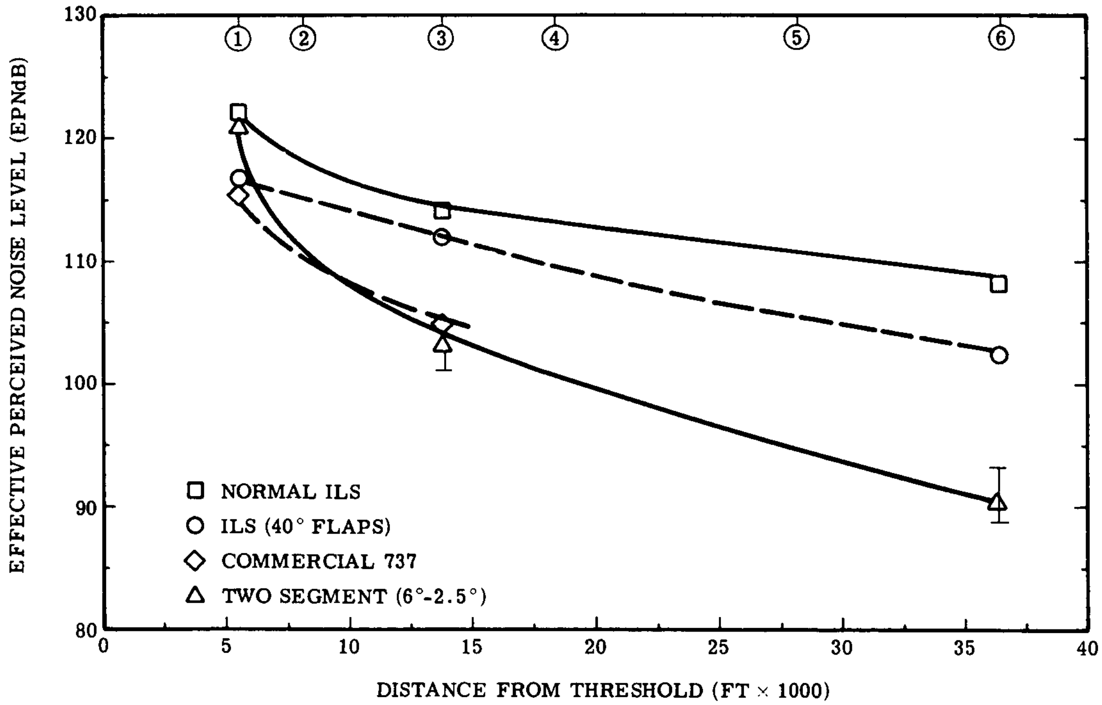


Figure C-11. EPNL Versus Distance Along Centerline on 3 September

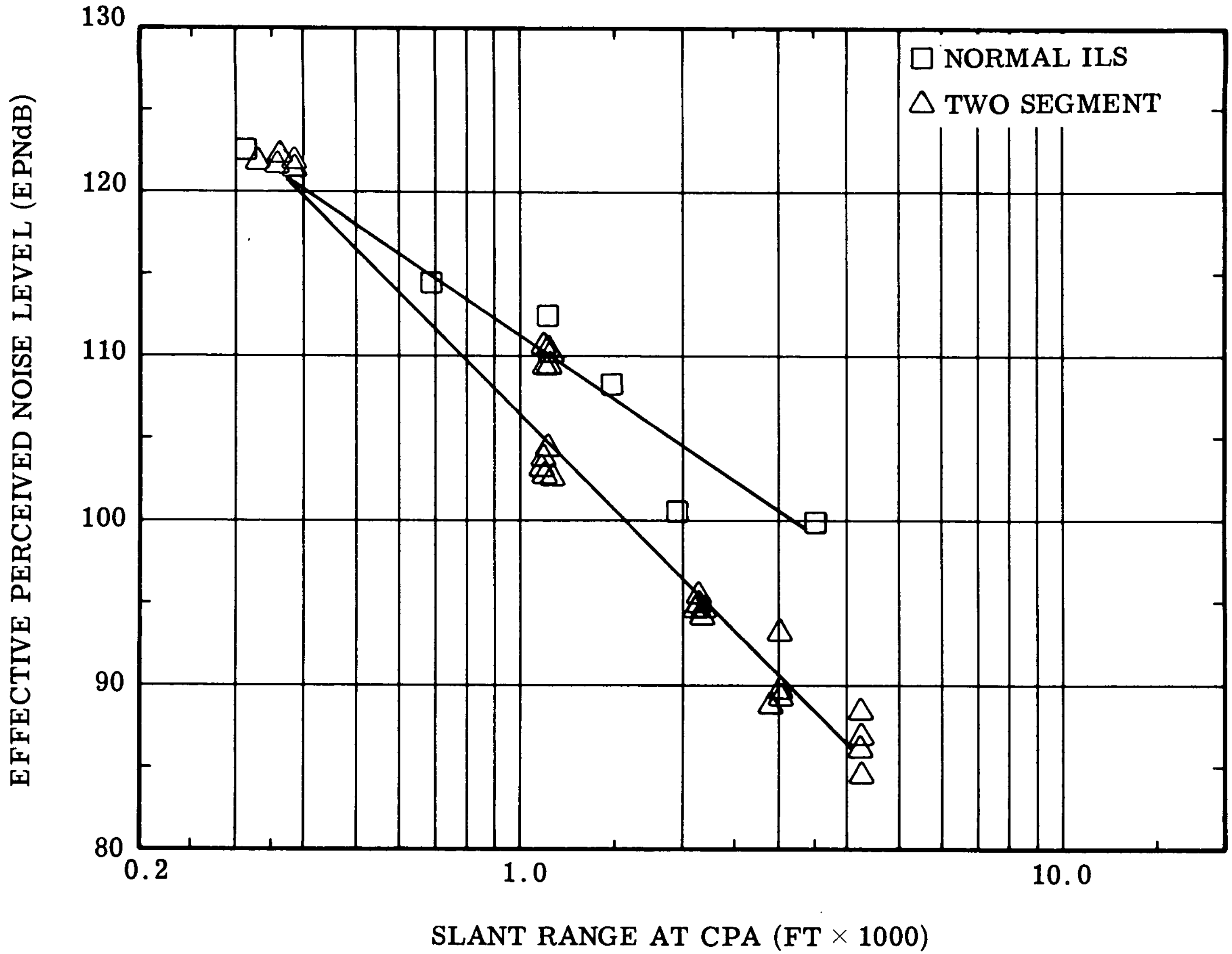


Figure C-12. EPNL Versus Slant Range on 3 September

Appendix D

HISTOGRAMS OF ACOUSTIC DATA

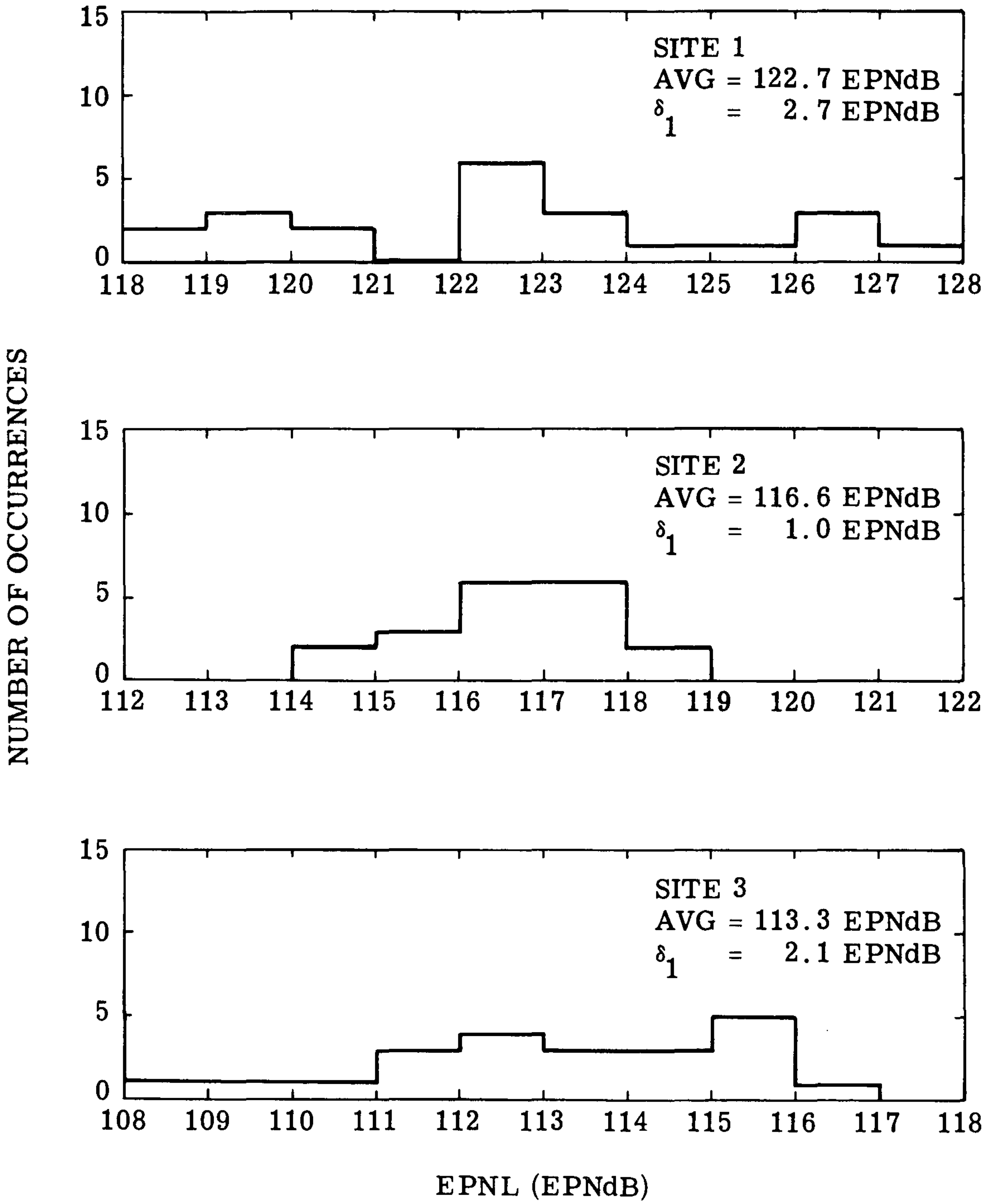


Figure D-1. Histograms for Group 1 Approaches - Sites 1, 2, and 3

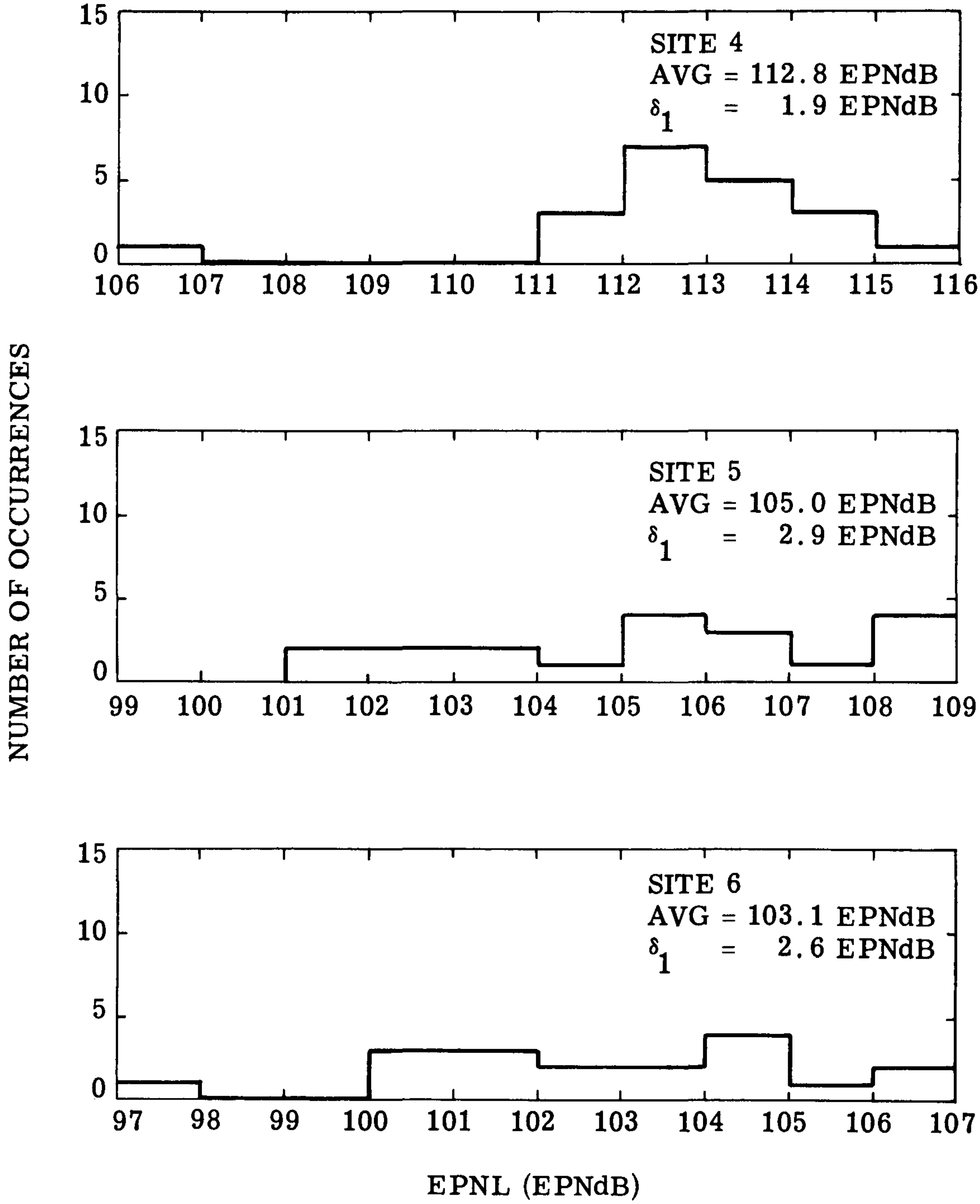


Figure D-2. Histograms for Group 1 Approaches - Sites 4, 5, and 6

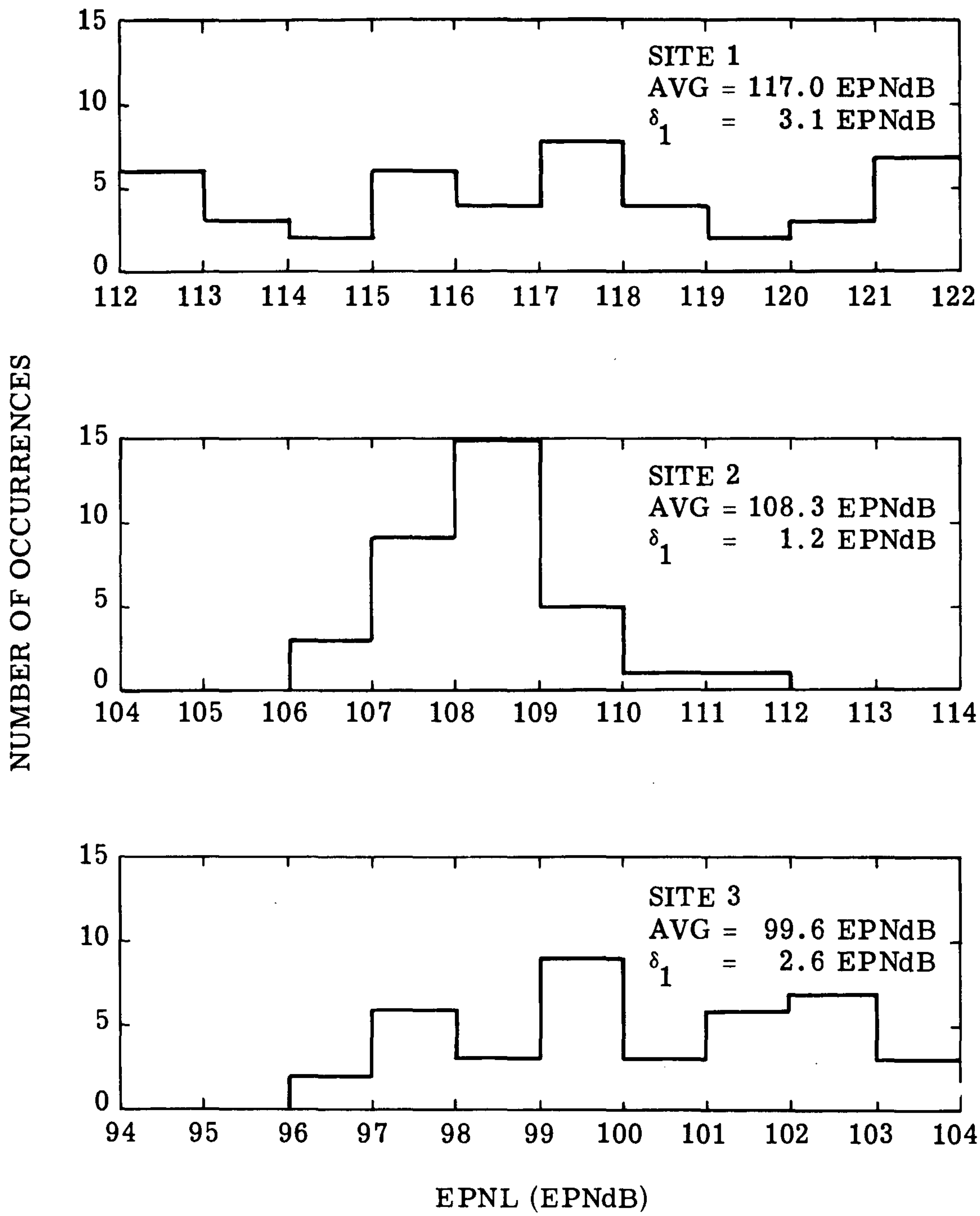


Figure D-3. Histograms for Group 2 Approaches - Sites 1, 2, and 3

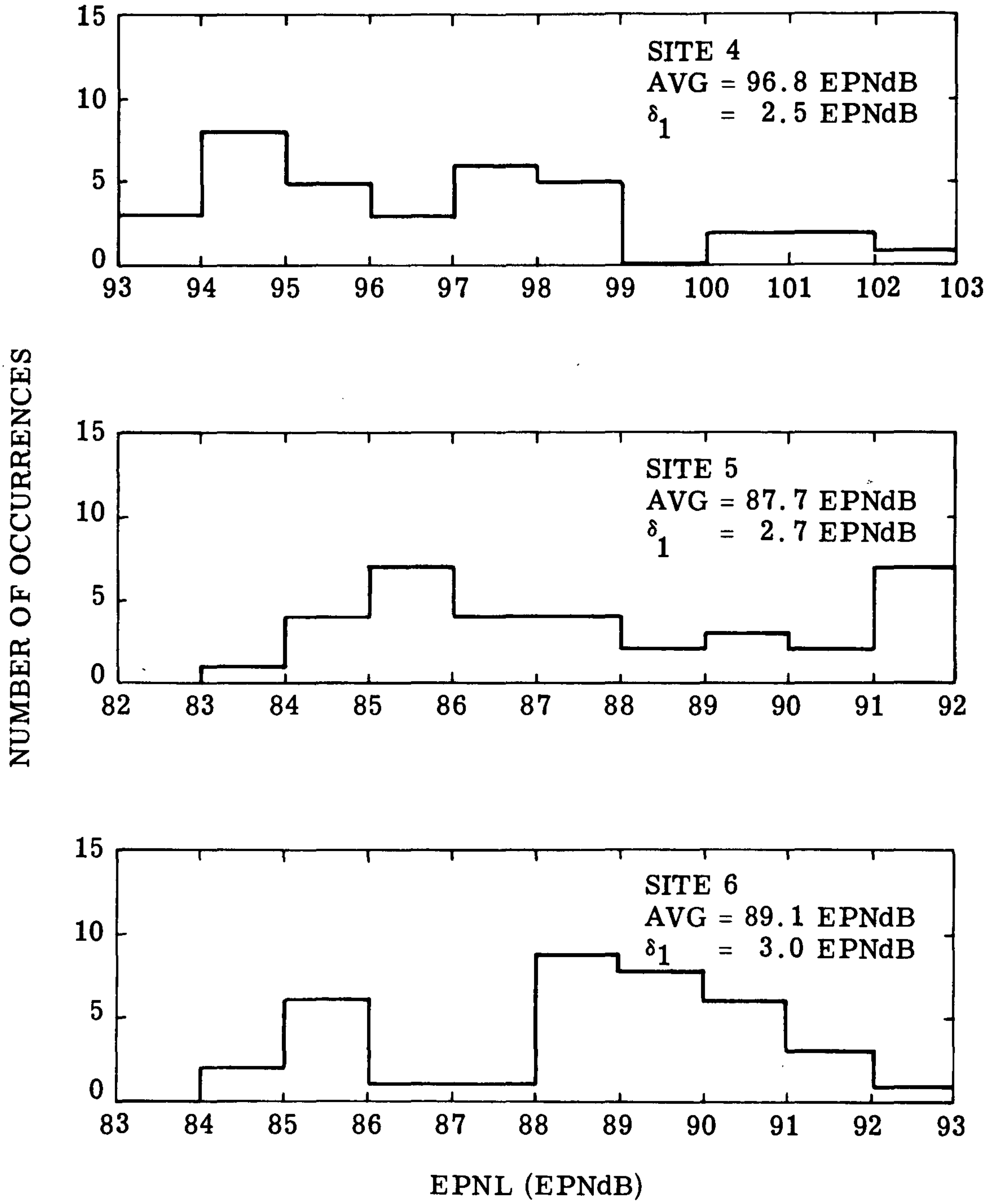


Figure D-4. Histograms for Group 2 Approaches - Sites 4, 5, and 6

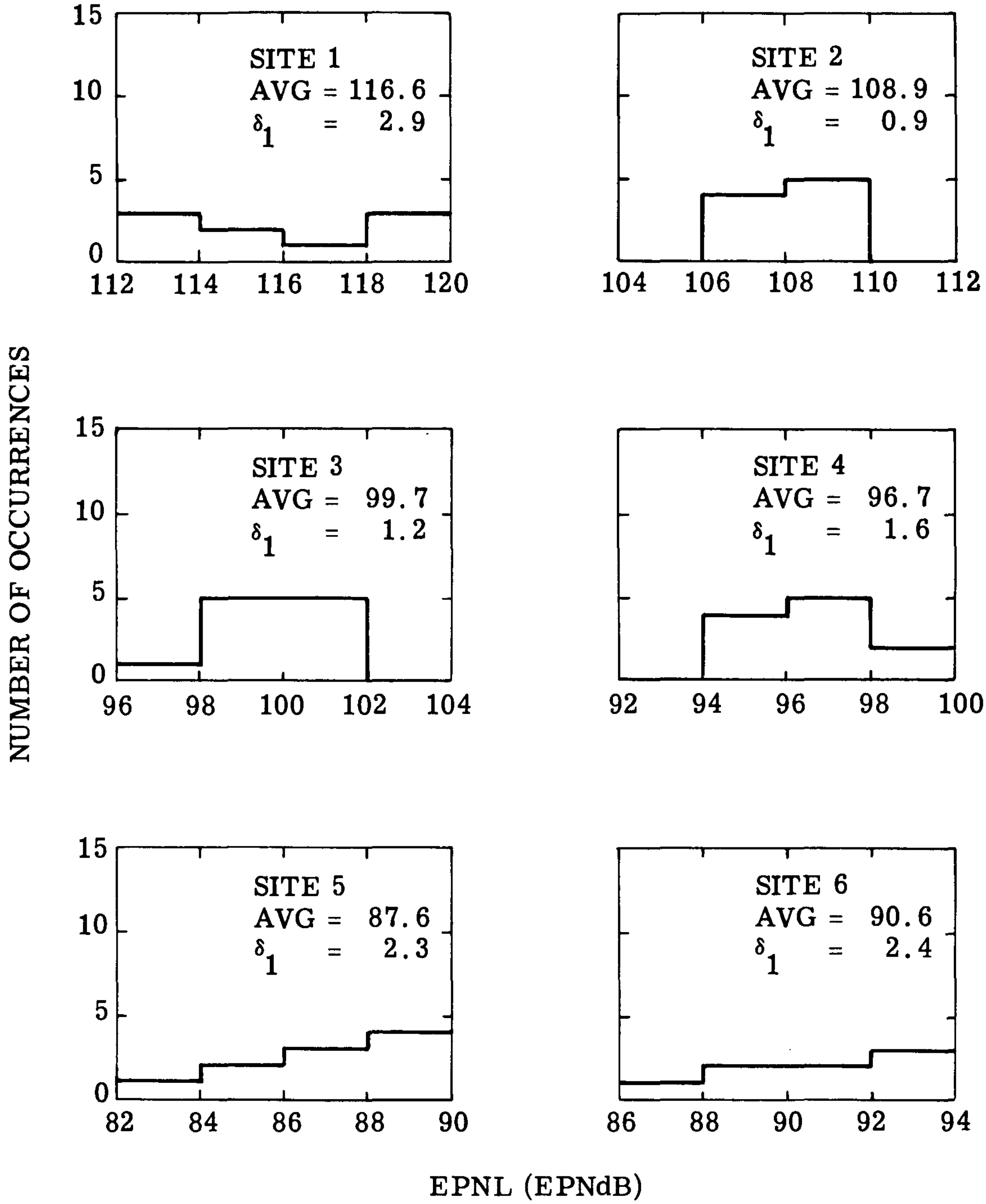


Figure D-5. Group 3 Approaches With Autopilot Procedure

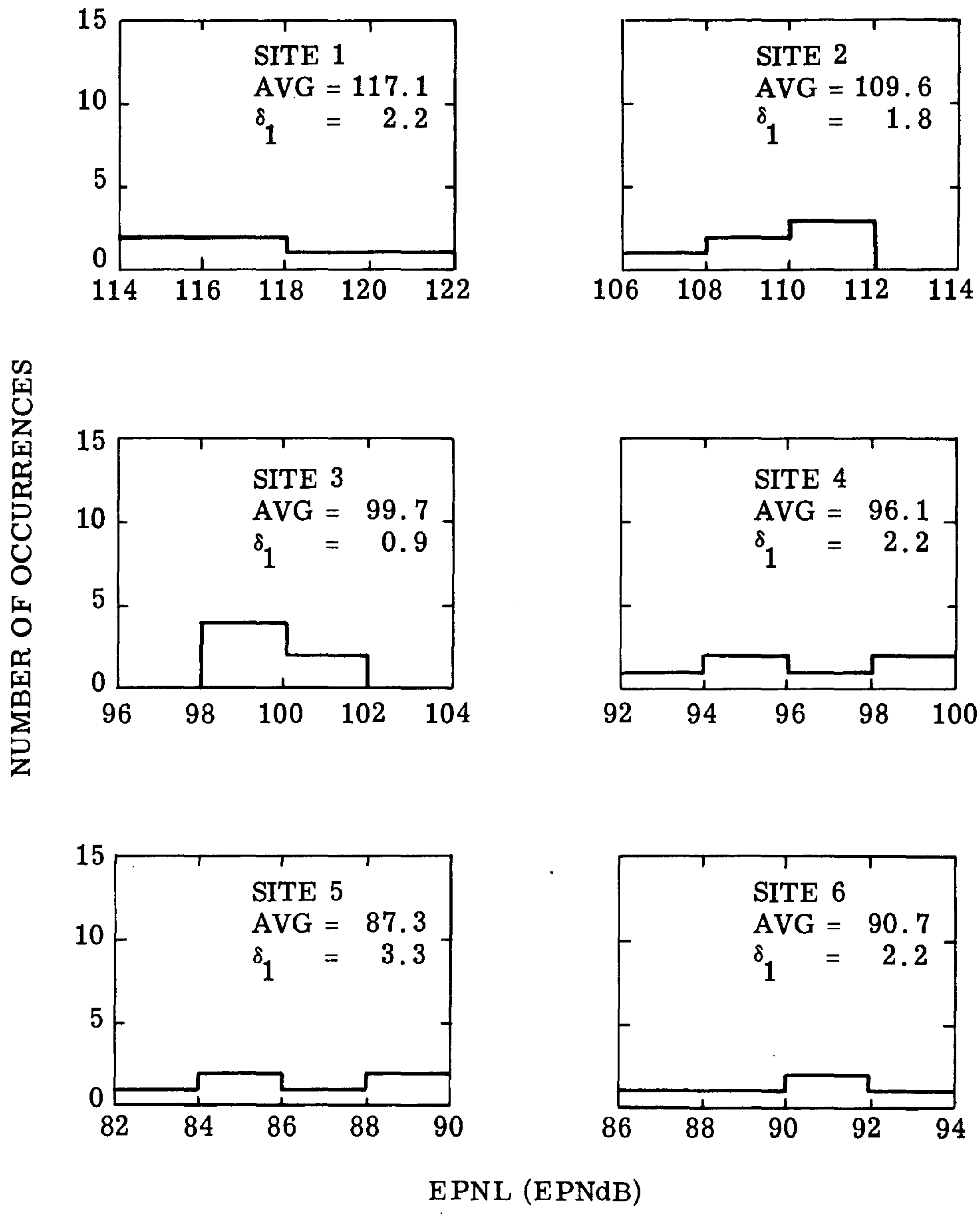


Figure D-6. Group 3 Approaches With Manual VFR Procedure

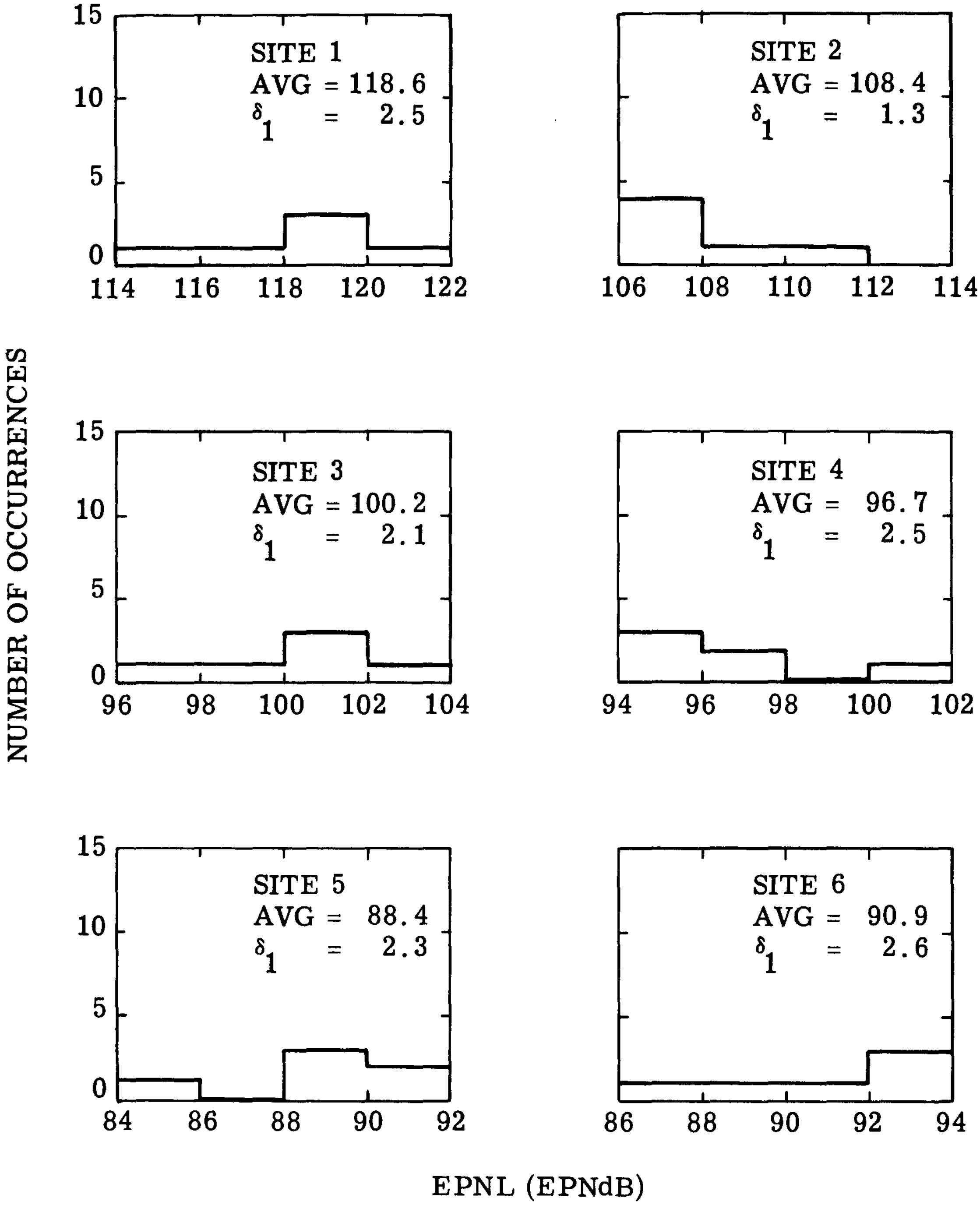


Figure D-7. Group 3 Approaches With Manual Hood Procedure

Appendix E

TWO-SEGMENT PRACTICE APPROACHES

The first five approaches from 24 August to 3 September were two-segment approaches flown for practice. The five practice two-segment approaches each day consisted of:

2 approaches using autopilot

1 approach using manual VFR

1 approach manually hooded

1 approach making upper segment excursions

The data in Table E-1 is the average noise level at each noise measurement site including all practice approach data acquired during the exercise.

Table E-1. Two-Segment Practice Approaches (EPNdB)

Procedure	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
Two Segment Autopilot	116.6	108.9	99.7	96.7	87.6	90.6
Two Segment Manual VFR	117.1	109.6	99.7	96.1	87.3	90.7
Two Segment Manually Hooded	118.6	108.4	100.2	96.7	88.4	90.9
Two Segment Upper Segment Excursions	116.3	108.5	99.1	94.6	87.9	89.3

Appendix F

SIDELINE MEASUREMENT RESULTS

Table F-1 contains the result of the three sideline measurement sites used on 2 and 3 September.

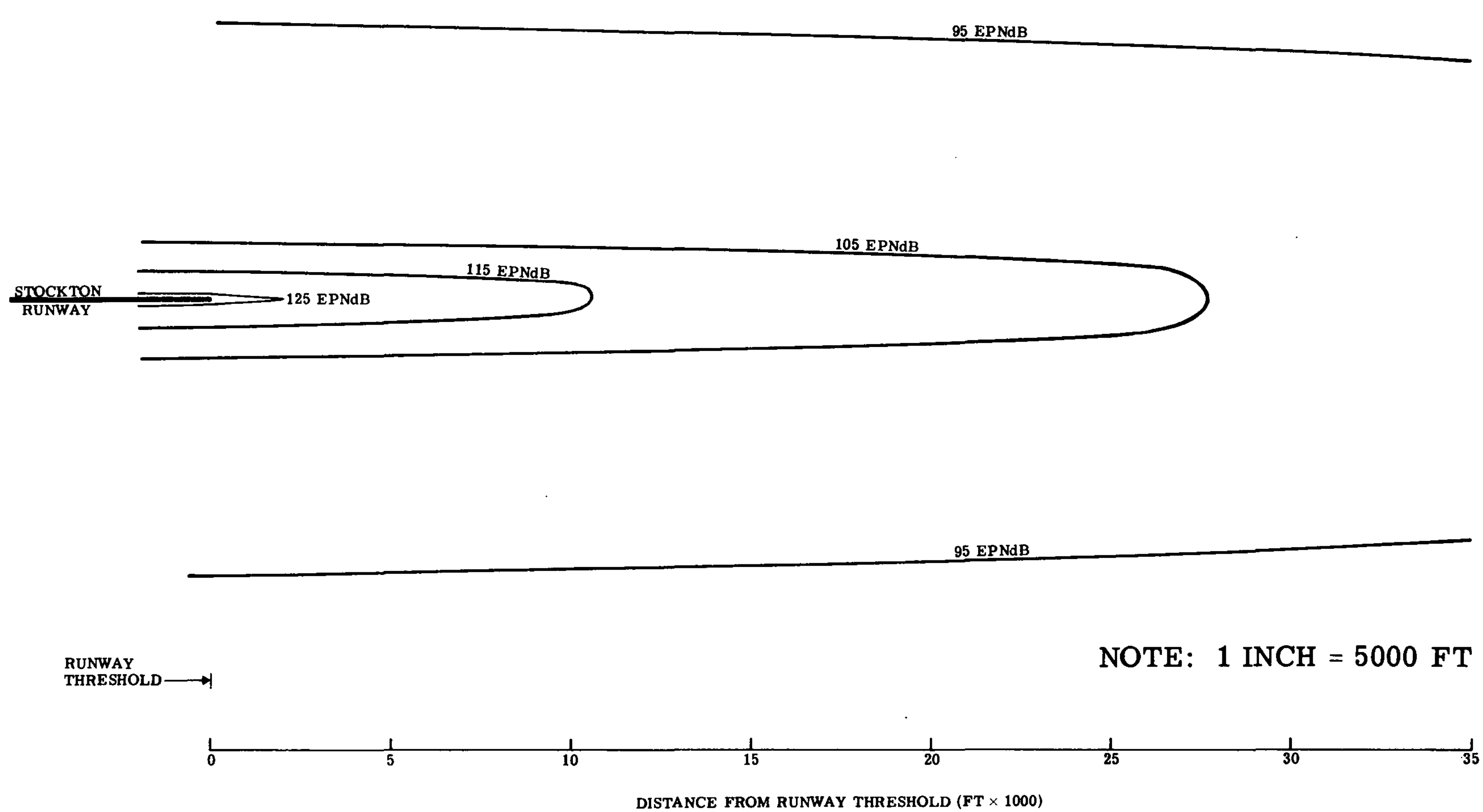
Table F-1. Sideline (EPNdB)

Group	Site 7	Site 8	Site 9
I (Normal ILS 50^{o} Flaps)	112.0	99.9	98.1
II (Two Segment)	109.4	93.4	87.1

Appendix G

EPNL CONTOURS

Figures G-1 and G-2 display the noise levels upon the ground due to both the optimum two-segment approach and the noise reference profile (Stockton ILS approach). The effective perceived noise level contours were computed using as inputs the altitude profile identified by the triangular symbol in Figure 8 and summary plots of EPNL versus slant range for the two-segment and normal ILS approaches. The accuracy of the contours is ±5 EPNdB. Note the large reduction in area encompassed by the 115-EPNdB contour, 105-EPNdB contour, and 95-EPNdB contour when the optimum two-segment approach is used instead of the normal Stockton ILS approach.



NOTE: 1 INCH = 5000 FT

Figure G-1. EPNL Contours - Normal Stockton ILS Approach

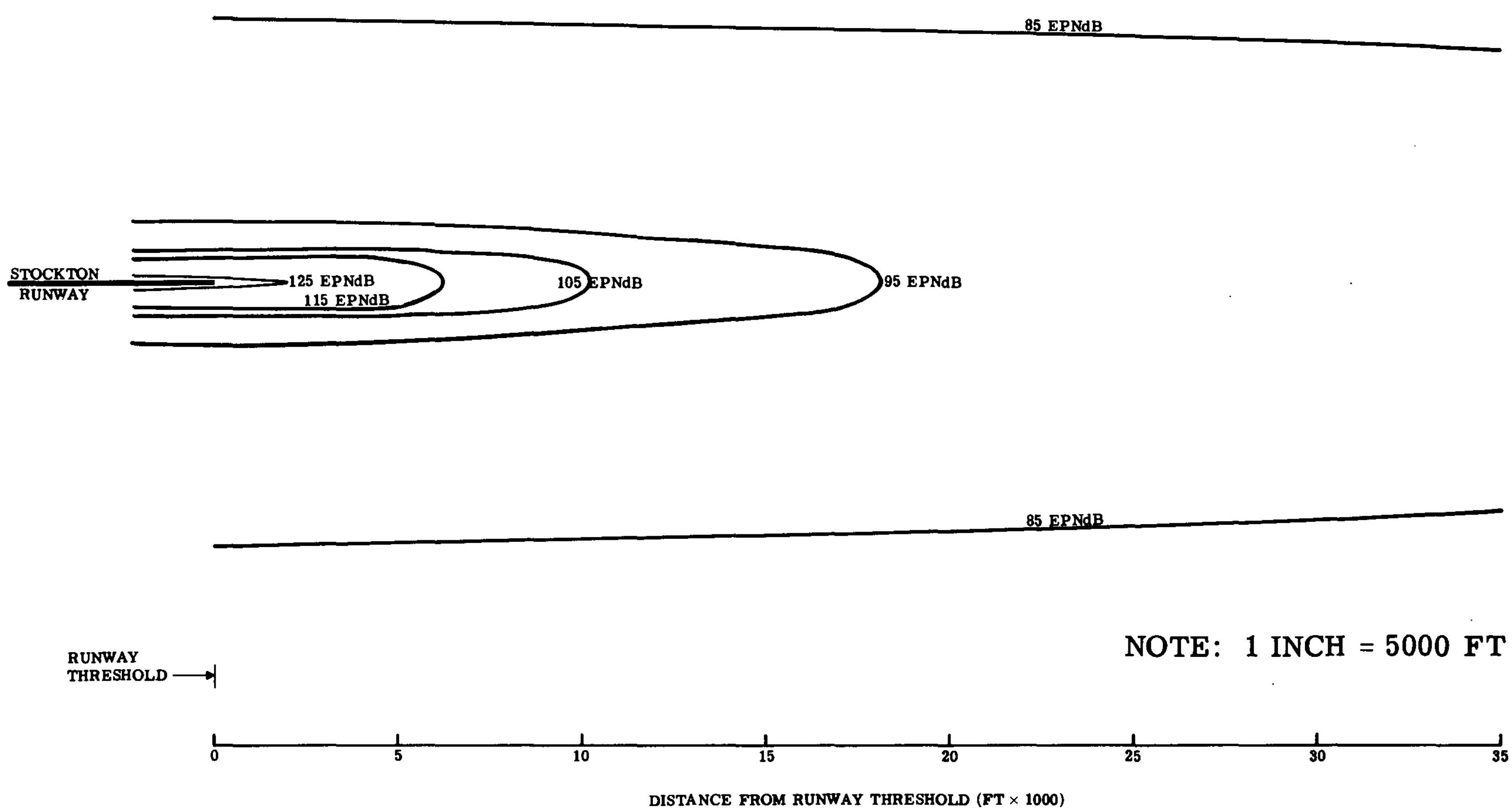


Figure G-2. EPNL Contours - Optimum Two-Segment Approach